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ELECTRICAL THEORY.

A great deal has been written in recent years by the advocates of the so-called new electrical theory, and a great deal of evidence has been produced to show that they are on the right track. These energetic workers have not been allowed to go ahead unopposed, as a great many distinguished physicists have refused to accept their ideas; in fact, among the new theorists themselves there is a lack of harmony respecting the extent to which the new ideas are to be applied. No one questions, it seems, the existence of subatomic particles, or at least negative electric charges without atomic dimensions. The acceptance of this idea gives some definiteness to the conception of negative electricity, but as yet no satisfactory idea of what positive electricity consists, nor how it is carried, has been offered. Starting at this point the differences in opinion begin. Some would build up the entire atom of these subatomic particles; others say the time for such a conclusion has not yet come, and we should limit the discussion of the atom to a material particle of comparatively large size. Whether this be built up of small particles common to all the elements can not yet be discussed profitably. Others, again, refuse to consider the possibility of transmutation of the elements which naturally follows from the electrical theory of atoms. Probably the most distinguished of this class of physicists is Lord Kelvin, as he has never accepted this theory. At the recent meeting of the British Association he read a paper explaining his ideas of the ether, and took occasion in this to give some of his conceptions of electrical action.

Lord Kelvin has abandoned his old theory of a fluid ether, and now suggests that the ether must be a solid compressible substance, perfectly homogeneous throughout. He finds no difficulty in conceiving such a medium.

He also contends that a velocity through the ether at a speed greater than that of light is possible, although this would call for a continual application of force. Many have assumed that such high velocity is inconceivable.

Regarding the electrical character of the atoms, it is noteworthy that Lord Kelvin accepts the idea of a subatomic negative charge. He believes that the atoms are then positively and negatively charged accordingly, as they are associated with more or fewer of these negative charges—and he points out that we have no evidence proving that an integral number of negative charges, or "electrions," as he calls them, will always just equalize the positive charge of an atom. Should this be true, such an atom alone would then always be charged one way or the other, and could only be neutralized when associated with another atom, as no number of electrions alone will balance its charge.

He suggests this idea to explain the diatomic gases, the atoms grouping together to neutralize their charges.

Lord Kelvin's paper is published on another page of this issue, and those who are following the newer theories of electricity will no doubt read it with a great deal of interest.

TANTALUM ELECTRODES FOR ELECTROLYTIC RECTIFIERS.

The use of aluminum for electrodes in electrolytic rectifiers is well known. A number of more or less practical designs based upon the asymmetrical property of this metal have been made, though it seems that the actual use of such appliances has been limited, due, most likely, to the excessive heating of the cells which takes place if they be not inconveniently large or provided with special cooling appliances. This heating is not only a sign of inefficiency, but it unfortunately hinders the rectifier from operating if the temperature rises above a certain point. The choice of electrolyte in such devices is rather large when aluminum is used, though, of course, certain solutions give better results than others. The one necessity is that the aluminum form an insoluble compound in the solution. This subject was very carefully studied some years ago by Pollock. He found out the best results, that is to say, a device which could be used for the highest potentials, were given by solutions of the aromatic series of hydrocarbons. That other metals would behave in the same way, though to a less extent, has also been known; but until recently no other metal at all comparable to aluminum and its effects has been available.

In a recent issue of the *Annalen der Physik,* Mr. Günther Schulze describes the behavior of tantalum when employed as an electrode for such rectifiers. This property of tantalum was noticed at the time that the metal was first brought forward as a substitute for carbon in the ordinary incandescent lamp, but little or nothing has been published describing in more detail its peculiar behavior.

It is interesting, in this connection, to review the most recent and what appears to be the most satisfactory explanation of this asymmetrical behavior of such metals. Heretofore, the explanation most generally accepted was that the action of the current caused an insulating coating to be formed over the surface of the metal when the current passed from the latter into the solution,—in other words, when the metal acted as an anode, and therefore was at the oxidizing end of the cell. This coating was supposed to interrupt the current simply by opening the circuit. When, due to the alternation of the potential, the metal became a cathode, the reducing action tended to destroy the insulating coating and thus allowed the current to pass from the solution to the metal. This explanation is not altogether satisfactory, for the interruption of one half wave current by the formation of this insulating current would seem to leave the metal in such condition that the next half wave, even though it came in the opposite direction, could not reach the metal; in other words, the circuit would remain interrupted. However, since it was known that there is not a complete interruption of the current, as a certain amount of so-called leakage takes place through the cell, and moreover, since this insulating coating disappears upon standing, apparently being dissolved by the chemical action of the electrolyte, the explanation was accepted until a better was forthcoming. The explanation which now receives most favor is that this insulating coating formed in the electrolyte is more or less porous and serves to hold a layer of gas given off from the electrolytic action of the current. The insulation of the electrode is thus due to a gaseous skin which is capable of withstanding a high potential gradient. This gradient is about 8,000,000 volts per millimetre when the current is passing from the metal to the electrolyte, and at about 100,000 volts per millimetre in the opposite direction. The difference is supposed to be due to the fact that the small, negatively charged particles given off by the metal when acting as an anode can pass more readily through the porous skin than the comparatively large particles or ions by which current must be conducted when flowing in the opposite direction, since the electrolyte itself can not give rise to the free negatively charged electrons; in other words, the skin forms what may be compared with a semi-permeable membrane which allows the electron to pass freely in one direction, but will not allow the ions of the solution to pass in the other until the potential gradient has reached a point sufficient to disrupt the membrane. The potential gradient necessary for this agrees fairly well with that found by Thomson for small spark-gaps, and if the potential be carried above that at which the particular cell will operate, the current is seen to pass in a series of small sparks.

The interest attaching to the behavior of tantalum when used in this way is due to its superior effect, for Mr. Schulze has not yet tried any electrolyte which did not behave fairly satisfactorily. With aluminum, although there are a number of fairly good solutions, there are a great many which will not serve at all. The difference is undoubtedly due to the fact that tantalum formed insoluble compounds in all the solutions tried.

There is another and still more important feature of the tantalum electrode. This is its indifference to the temperature of the solution. With aluminum, as has already been mentioned, the rectifying action ceases when the temperature reaches a certain point; with tantalum there seems to be no such limit. Therefore, a rectifier might possibly be constructed which would give satisfactory results although the solution was raised to the boiling point and dissipated its heat in the steam thus generated. Another valuable feature of tantalum is the relatively high potential gradient which the coating formed upon it will stand. Mr. Schulze found that this varied from seventy volts in a concentrated solution of potassium hydrate to 650 volts in a very dilute solution of sodium or potassium carbonate. Pollock found that only with the aromatic series of hydrocarbons could he carry the potential up to several hundred volts when using aluminum.

Unfortunately, tantalum is a rather expensive material at the present time, but as the supply is not small, and as more attention is given to its production, it may result that we will at last have available a satisfactory electrolytic rectifier. Such

a device will, of course, find very wide use in many ways. Magnesium is another metal having the asymmetrical property, but not to a degree comparable with tantalum.

STEALING ELECTRICITY.

An important case has been brought up in the New York courts in which an individual is charged with stealing electricity, or rather, with supplying others with apparatus intended for this end. While such thefts are going on continuously in many and in probably all large cities, convictions are rather rare. A few years ago there used to be a difficulty in securing convictions because of a technicality, it being held by some judges that a thing which could not be seen could not be stolen. However this argument might appear to a lawyer, to an engineer it is certainly weak, and it possibly might have been set aside by proving that electricity is merely one form of energy, and in the form of light is visible. The mere fact that the person who stole the electricity changed its form could hardly be urged against this argument, because the forms of things stolen are frequently changed. The thing itself would be really the same, as the ultimate object of the discussion is energy. A lawyer might possibly find objection to this line of argument, but, fortunately, in many cities the difficulty has been overcome by laws dealing with this particular theft, these laws being especially designed to prevent thefts of electricity and gas.

However that may be, there is a great deal of difficulty in securing convictions, for it is generally required that evidence of actual theft, and not of an intention to steal, must be proved; in other words, the use of the device or arrangement intended to defraud the company must be proved, its mere presence in a place where it might be used for this purpose not being considered sufficient. For this reason the electrical supply companies, although they know that stealing is going on, are frequently obliged to delay a long time before they can take any action. This question was pretty thoroughly discussed at the recent meeting of the Ohio Electric Light Association, when the many troubles confronting the companies were explained. It has been found in many cases advisable to let the matter go on for some time until a good example could be made of some one offender. A few such examples prosecuted and convicted would be sufficient largely to stop the practice.

The particular case which has just come up is interesting because of the method employed. Frequently plans have been adopted for interfering with the action of the meter, either by destroying its bearings or shunting it, or in some way interfering with the free motion of the moving part. Such interference is not hard to detect, however hard it may be to prove who did it. In the New York case another plan was adopted. In this the interference with the meter was only temporary, the aim being to turn the instrument backward during a time when the appearance of an inspector need not be feared. At other times the device was removed and the instrument operated normally. The plan was to place a powerful magnet over the instrument arranged so as to drive the moving part backward. The exact way in which this was done has not been made clear. The scheme, however, was ingenious and difficult of detection. In this case the oversight of one of the purchasers of the so-called regulator led to the discovery.

It is rather interesting to inquire why gas and electric meters are such universal objects of scorn and distrust. As far as the electrical instrument is concerned, it is safe to say that it is as accurate as the measuring devices deemed satisfactory in other lines of commerce—in fact, it is probably more accurate than many such instruments, and when it does go wrong it is more likely to offend against the seller than the purchaser. The reason for this antipathy is no doubt psychological. It possibly may be started by an over-enthusiastic solicitor who tells the prospective user of electric light that this system will not cost him any more than gas, without also telling him that, of course, the cost of the new system will depend entirely upon how many lamps he uses. He, as long as he is making a change, thinks he might as well improve matters, and the result is that his monthly bills are larger than anticipated. Frequently, also, the convenience of the new system leads to its increasing use, so that the monthly bills gradually creep up. Another reason is the increased cost of lighting with the approach of winter. The consumer is very apt to compare his fall bills with those of summer, and then object to the increased amount.

There is possibly another reason for this general dislike to pay for electric lighting. One will gladly pay for a thing if he intends to make use of it. He has in mind the pleasure and profit before him, and the cost takes a secondary position. On the other hand, he has no such pleasure in paying for something that has been used and from which no future pleasure may be expected. This phase of the question probably could be met by the use of prepayment meters, and might be worth trying. But the general education of the public, such as is going on continually, is better and the willingness on the part of the companies to have the meters inspected at any time and as often as the consumer wishes should inspire the latter with confidence in his instrument. This plan of educating the public in the use of electricity, moreover, has other advantages which are not less valuable.

THE CANADIAN ELECTRICAL SHOW.

On the evening of Monday, September 2, the exhibition of the Canadian Electrical Exhibition Company, Limited, opened at the Drill Hall, Montreal, Quebec. This is the first exhibition of its kind in the Dominion in seventeen years. A report, on another page of this issue, indicates the evidences of enthusiasm and success which attended the opening night. Manufacturers of electrical apparatus are contributing largely toward the industrial prosperity which Canada is now enjoying. This is easily understood after a study of the series of articles on Canadian electrical manufacturers and Canadian industrial development appearing in the last issue of this journal and which have created a good deal of favorable comment from our friends in the Dominion.

THE CANADIAN ELECTRICAL SHOW.

OPENED AT THE DRILL HALL, MONTREAL, SEPTEMBER 2. TO RUN UNTIL SEPTEMBER 14.

(Special Report to the Electrical Review.)

MONTREAL, QUEBEC, September 2.—The first exhibition of the Canadian Electrical Exposition Company, Limited, opened its doors to the public on Monday evening, September 2, at the Drill Hall, in Montreal, with every indication of a successful two weeks' show.

The hall selected, which is the largest of its kind in the city, is well adapted for a purpose of this kind. It contains approximately 30,000 square feet of available space, of which practically all has been sold.

The decorations and booths are tasty in appearance, the illumination effective, with the exhibits well arranged and representative.

A musical programme will be provided for each evening and special days observed, including Edison Day, Alexander Graham Bell Day and Benjamin Franklin Day.

An electric fountain in the centre of the hall and high-tension static machines are features of the show.

Practically all of the prominent electrical concerns of Canada are repre-ented, with a number from the United States. The exhibition company, of which Mr. R. S. Kelsch is managing director, deserves considerable credit for the excellent showing.

A feature of the exhibition is the "dancing skeleton," which is a duplicate of the one which was one of the attractions of the Chicago Electrical Show of last January. It is operated by a flasher and is part of the exhibit of the Reynolds-Dull Flasher Company, of Chicago.

During the period of the show the Canadian Electrical Association, the Canadian Street Railway Association and the Maritime Provinces Electric Light Association will hold their annual conventions in Montreal. The following are among the exhibits of note:

Wireless messages are sent by the Marconi Wireless Telegraph Company, which has receiving and sending stations in booths at different ends of the hall.

Electrical household appliances of the most modern type are exhibited in large variety by the Montreal Light, Heat and Power Company.

The Packard Electric Company's exhibit of induction motors, meters, etc., with the Jandus series alternating-current system, and Crocker-Wheeler apparatus is attracting a great deal of attention and occupies a prominent position in the centre of the hall.

The Sunbeam Incandescent Lamp Company and the Holophane Company are exhibiting through the Engineering Department of the National Electric Lamp Association the most brilliant display of tungsten, tantalum and Gem metallized filament lamps with Holophane reflectors ever seen in Canada. The tungsten lamps are being shown in the forty-candle-power street series, eighty-candle-power multiple, twenty-seven-volt and miniature types. The new tantalum Meridian units in twenty and forty candle-power are among the new tantalum lamps exhibited. A large number of Holophane globes and reflectors of various patterns and sizes are attracting attention. The exhibit can easily be distinguished from all others in the Drill Hall on account of the large amount of light, and is worthy of the attention being given it.

Of special interest to electrical men is a 2,500-kilowatt step-down transformer, from 44,000 to 12,000 volts, a 1,000-kilowatt direct-current generator, a large static sign and a working exhibit of a ten-kilowatt, direct-current, belt-driven generator connected to an alternating-current motor, all shown by the Canadian Westinghouse Company, Limited. It may be mentioned in this connection that a large part of the lighting of the hall is by means of Nernst lamps.

Of interest to the feminine visitors is a complete electric kitchen, showing every utensil usable in a modern kitchen, operated electrically. There are also shown the indestructible arc lamp, mercury arc rectifier for changing alternating to direct current, and tantalum, tungsten and Gem lamps exhibited by the Canadian General Electric Company.

There are two features in the exhibit of Allis-Chalmers-Bullock, Limited, which attract general attention. A booth across the aisle from the main exhibit is fitted up as a winding and assembling department, and here a number of men and girls from the factory show the process of building up induction motors from the point where the wire is insulated until the motor is ready to operate. Across one end of the main exhibit is a forty horse-power induction motor running at 170 revolutions per minute and driving a two-stage, three-inch Worthington centrifugal pump, made by the John McDougall Caledonian Iron Works Company, Limited. On a small scale, for the capacity of the pump is only 360,000 gallons per day, it represents the electric pump and motor made by the same firms, now in operation at the McTavish street pumping station, with a capacity of 5,000,000 gallons daily. Attached to the pump is a double needle nozzle, showing the method of controlling water when used to drive a double tangential water-wheel. In this case a one-and-one-quarter-inch stream is forced horizontally through the air under a pressure of 120 pounds into a "killer" and thence dropped into the tank, from which the pump is fed. The McTavish street pump works under a pressure of 110 pounds, and another in Toronto made by the same firm under a pressure of 300 pounds.

Allis-Chalmers-Bullock, Limited, also exhibits a number of alternating and direct-current motors and generators, transformers, switchboards, etc., made at its works in Montreal.

F. R. S.

Large Projected Station in Buenos Aires.

The Compania Alemana Transatlantica de Electricidad, Buenos Aires, which owns several small stations for supplying light, power and tramways in Buenos Aires, has decided, according to *Electrical Engineering*, London, for the sake of economy, to erect one large generating station, and to shut down the existing power stations, converting them into transformer and reserve stations. The new station is to be situated on an arm of the dock Sud outside the boundaries of the city. An arrangement has been made with the Great Southern Railway to dredge a branch of the dock Sud so as to admit of ocean colliers coming alongside the company's wharf. The capacity of the new station is to be approximately 95,000 kilowatts. Each of the five bays of the boiler house will contain twelve boilers. These bays will be at right angles to the dock, and will be fitted with overhead bunkers. The coal-conveying equipment will be very complete. The turbine house will run across the end of the boiler house, with a special intermediate bay, which will be necessary to the plant, and the switchboard room will be built on the other side of the turbine house. The buildings will be of steel and concrete. Condensing water will be drawn from the dock and carried by means of an underground tunnel under-

neath the dock, and discharged into the river Plate, about one mile away. Between each boiler house and in the centre will be placed the chimneys, six in number. The boilers will be of the Babcock & Wilcox patent water-tube marine type, each with a total heating surface of 5,233 square feet, and fitted with superheaters. In order to facilitate the unloading of the machinery from the steamers, and as various parts will be of great weight and size, the Compania Alemana has been supplied with a floating pontoon equipped with shear legs, so that a weight of sixty tons can be lifted out of the ship's hold, and either placed in barges alongside or carried upon the shear legs of the pontoon itself. The pontoon is equipped with steam windlasses for mooring and warping operations. The hind leg of the shear has an inward and outward travel, mechanically operated so that the weight to be lifted can come on board on the pontoon or the shear leg can be projected over any ship's hold.

The Manufacture of Calcium Carbide in England.

An interesting attempt to provide a useful day load for large electric power stations shortly to be tried is briefly described in *Engineering,* London. A company under the title of the British Carbide Factories, Limited, has commenced the erection of a factory for the manufacture of calcium carbide in Yorkshire, the power to be taken from the mains of the Yorkshire Electric Power Company, Limited, during the hours of light load. The carbide works will be equipped to take a maximum of 2,500 electric horse-power to commence with, and during the hours of peak load on the generating station the supply to the factory will be practically cut off, the carbide furnaces being then fed, we gather, from a kind of storage of electrical or other energy. The Yorkshire Power Company's station is at Thornhill, near Dewsbury, and was opened in 1905. It has a rated output of 6,000 kilowatts, and generates three-phase, fifty-cycle alternating current at 10,000 volts. The total connections of all kinds amount to about 3,000 kilowatts, but the maximum load on the mains is only 900 kilowatts. The price charged to users is $20 per kilowatt per annum of maximum demand, plus from 0.7 to 1.6 cents per unit. The price to be charged to the carbide company is not stated, though in view of the nature of the load and the large amount of idle plant it would give employment to, a very low figure could be quoted. Upon this, of course, depends the successful competition of the works with the cheap water power of the Continent. The Thornhill factory will draw its raw material from the immediate neighborhood. The production of carbide is expected to commence within the year, and if the experiment is successful, a very important factor in the cheapening of electric power in England, as well as a practically new industry, will have been established.

History of Electrical Applications.

To the Editor of the Electrical Review:

In an editorial in your issue of August 24 you say, "If the student should go back over the history of electrical applications, he would find many instructive lessons."

This suggests the question whether there is any satisfactory book on the history of electrical applications that would be suitable for a student's use. I do not know of any such book, but if one were to be written, I should think it would fill a very important purpose. I would like to see a book in which the following questions were answered in language that could be understood by a junior student in an electrical or mechanical engineering course:

1. What were the steps that had to be learned before Faraday's work was developed into Gramme's dynamo?

2. What delayed the discovery of the reversibility of the dynamo and the introduction of the electric motor?

3. What were the limitations and troubles of early dynamos and motors of the various kinds: series, shunt, compound and overcompounded, in commutating, sparking, heating, speed control and adaptability for various purposes?

4. Same as to alternating-current machinery?

5. What difficulties and troubles yet remain and what need is there for further improvement?

What is wanted is an elementary historical treatise on dynamoelectric machinery, clearly illustrated, showing the evolution of electrical engineering through difficulties and troubles to its present state. Silvanus P. Thompson would be just the man to write such a book. His address before the Engineering Section of the British Association, if expanded and illustrated, might form the first chapter.

Yours truly,

Wm. Kent,

Dean of College of Applied Science.

Syracuse, August 31, 1907.

Association of Edison Illuminating Companies.

The annual convention of the Association of Edison Illuminating Companies will be held at Hot Springs, Va., September 10, 11 and 12. The following convention programme has been announced:

There will be reports from the six special committees of the association, as follows:

Committee on Electric Heating, John F. Gilchrist, Chicago, chairman.

Committee on Incandescent Lamps, J. W. Lieb, Jr., New York, chairman.

Committee on Meters, J. W. Cowles, Boston, chairman.

Committee on National Code, W. C. L. Eglin, Philadelphia, chairman.

Committee on Steam Turbines, Charles H. Parker, Boston, chairman.

Committee on Storage Batteries, Louis A. Ferguson, Chicago, chairman.

Two subjects are to be specially introduced for discussion as follows:

"Sales of Industrial Power," introduction by Louis A. Ferguson, Chicago.

"Periodic Inspection and Testing of High-Tension Apparatus and Lines," introduction by P. Junkersfeld, Chicago.

Papers will be read as follows:

"Experimental Data on Illuminating Values," Dr. C. H. Sharp, New York, and P. S. Millar, New York.

"Smokeless Furnaces for Power Plants," W. L. Abbott, Chicago.

"Steam Heating from Central Stations," Bingley R. Fales, Detroit.

"The Boston Edison System in 1907," L. L. Elden, Boston.

"The Status of the Wholesale Customer," Jas. V. Oxtoby, Detroit.

"The Raising of Power-Factors and the Regulation of Potential by the Use of Rotary Condensers," C. V. Stone, Schenectady.

"Organization of an Electric Supply Company, with Particular Reference to Its Dealings with Customers," R. S. Hale, Boston.

"The Status of Municipally Owned and Operated Lighting Plants in Massachusetts," L. R. Wallis, Boston.

"The Work of the Electrical Testing Laboratories," Wilson S. Howell, New York.

"A Proposed Electric Mutual Insurance Company—a Report," S. C. Mumford, Detroit.

Dr. Charles P. Steinmetz has promised to talk on the subject of high-potential disturbances in electric circuits. By request Dr. Steinmetz will touch on phenomena recently observed on underground systems of large capacity.

ELECTRICAL NOTES FROM EUROPE.

(By Our Special Correspondent.)

IT is expected to make a new connection between Switzerland and Italy by means of a line of standard gauge railroad which will be operated electrically, at least for the greater part. The project includes the building of a new tunnel of considerable length, this having 13.9 metres on the Swiss side and 12.2 on Italian territory, connecting the station of Andeer with Callivaggio. By this means trains starting from Coire, on the Swiss government railroad, will follow the new line by way of Roth Thusis and Andeer, then proceed through the tunnel and pass by Callivaggio, Santa Croce and Chiavenna. At the latter point, which is a station lying upon the Lecco-Sondrio Italian system of electric railroads, trains will be taken over this line and will run from thence upon the Italian track line to Milan or Venice. It is expected that the new tunnel, according to the project laid out by Dr. Locher-Freuler, a prominent engineer, will take about eight years to construct and will rival the Simplon tunnel in interest. A single track will be laid in the tunnel, with three different sections of double track which are used for the crossing points. The total length of the tunnel will be 15.8 miles. In the future a second tunnel may be constructed alongside the first. The track and rolling stock of the new line will be the same as is now used on the Swiss government railroads, and the maximum grade is 2.6 per cent. A type of electric locomotive which is to be chosen later on will be used for the through trains, while it is probable that the local trains will use motor cars.

One of the newest electric automobiles to be brought out at Paris is the Dinin car, which is built in different types for two, three or four places. All the mechanism, together with the measuring instruments, controller, cables, etc., forms part of the chassis of the car, so that it is independent of the carriage body. A single motor suspended on the hind axle is used to operate this axle directly, by means of a differential of the usual form. The motor is of the iron-clad pattern and has four poles. Ball bearings are used here to great advantage. The differential is placed in the centre of the rear axle, with the motor lying on one side. There are two brakes mounted on the chassis. One of these is operated by the controller pedal. When it comes to the end of the stroke it breaks the current and the brakeshoes act upon the rear wheels. As to the second brake, it operates by a set of jaws upon a cylinder mounted on the shaft of the motor. The controller of the Dinin car is formed of two separate drums, the first of which is designed to give the different speeds of the motor, while the second acts to reverse the current so as to run the car forward or backward. Both drums are enclosed in an aluminum case. A pedal rotates the speed cylinder of the controller, and when this comes to the end of its stroke, the brakes are thrown on. The second drum is worked by a handle placed on the steering wheel, in which case the speed drum must be in the off position, and this is carried out by means of an interlocking device. Two different boxes contain the storage battery, and in order to give a better distribution of the weight, one of the boxes is placed in front while the second lies in the rear of the car. Forty-two cells are used here, giving 110 volts. The new car is now manufactured at the company's works near Paris.

An electric railroad project of considerable interest is the line which it is proposed to run in Austria between Vienna and Budapest. High-speed trains can thus be operated between the two cities. According to the first plan of laying out the road, it will pass from Budapest by way of Presburg and Theben and after crossing the Danube it reaches Vienna, having its terminus at Karlsplatz. Where the line crosses the city it is expected to run it in a tunnel. This line will be of entirely new construction. As to the second project, it is desired to make use of some of the already existing tracks in the region. There are now two local lines whose tracks can be used for part of the way, the first of these being the Budapest-Gran railroad, and the second the Komorn-Presburg and the Vienna-Presburg which is soon to be constructed. It is said that an American company is backing the project, and that it is favored by the Hungarian government. A double-track line will be used throughout the entire length, and in some of the localities there will be four tracks.

At Paris a number of experimenters are using the electric furnace in order to obtain a series of new compounds which can be formed at a high heat. Within a recent period quite a number of such compounds have been obtained. One of these is the silicide of molybdenum, which is prepared by a prominent worker, Ed. Defacqz. A mixture of amorphous molybdenum in powder and silicide of copper, in the proper proportions, is subjected to the heat of the arc for about two minutes, using an arc of 1,000 amperes and fifty volts. In this way he obtains a melted mass from which he is able to separate the silicide of molybdenum, and it appears in the form of small needle-like crystals of a gray color and having a density of 6.2 at the freezing point.

The manufacture of peat briquettes is now carried out on a large scale at a new plant which has been erected not far from Munich, at Benersburg, on the banks of the Loisach stream. What is to be remarked is that electric motors are used to a large extent in the present plant. The Ziegler process is employed in this case for the treatment of the peat. After coming from the bogs it is taken by motor-driven conveyers to the different machines by which it is formed into blocks. Each of the Ziegler apparatus is supplied by a twenty-horse-power motor, and there is a generating plant installed at the works for producing the current which is needed for the motors as well as for the lighting of the factory. The first machines are designed to form the peat into blocks, and after a partial drying it is taken to a set of furnaces for further treatment. There are four of these furnaces running at present, and the conveyers are worked by small electric motors. A system of electric fans is used for drawing off the gas which comes from the peat. The first set of furnaces works at a low heat, and then the peat is transferred to a second set of furnaces where it is formed into coke at a higher heat. At present the capacity of the plant is about ten tons per day.

It is expected to operate the railroad line which runs up the mountain of the Rigi in Switzerland upon the electric system. This line is known as the Goldau-Rigi system, and the Swiss commission, which now has the matter in hand, is taking measures to have the electric outfit installed before the end of this year. Steam locomotives were formerly used upon this line. A novel point will be the method which is to be adopted for operating the electric locomotives. The motor will take the car up the grade, but in the down run it will not be used, and the speed of the car as it runs down the slope will be regulated by a special system of brakes, such as is now used upon the steam locomotives.

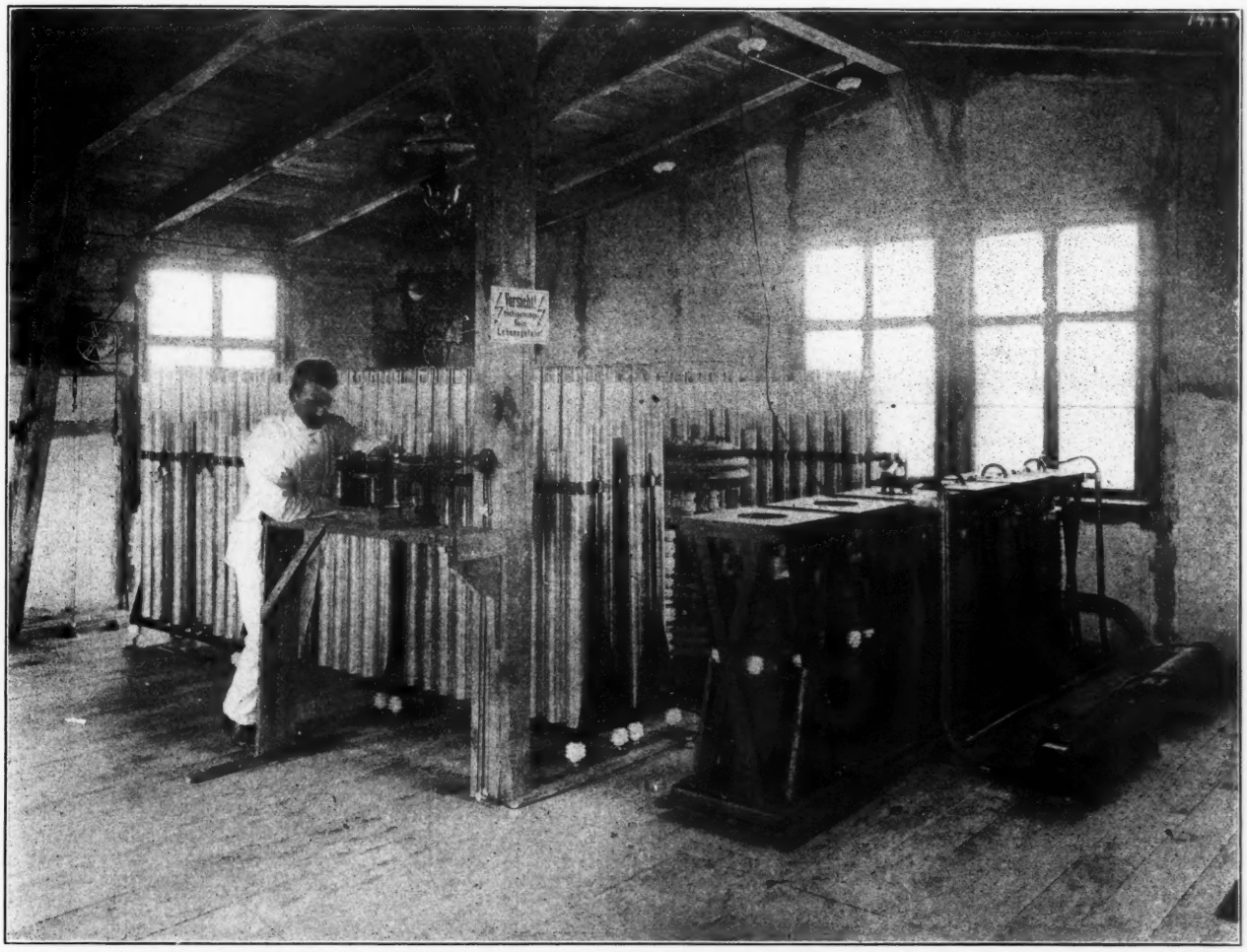
C. L. DURAND.

Paris, August 24.

The Radio-Telegraphic Station at Nauen, Germany.

By B. F. Hirschauer.

ONE of the most interesting, as well as the largest and best equipped of the Continental radio-telegraphic stations is without doubt the post which has been erected at Nauen, near Berlin, by the German Wireless Telegraphy Company, on what is known as the Telefunken system. Ever since its erection, the new plant has proved a great success, and at present it is able to send messages overland for distances ranging from 1,000 to 1,500 miles, and this with a regular interchange of messages. It is only of late that the company started to build stations of long range. The reasons for this lie in the fact that on the one hand the company has been much occupied in equipping stations of normal range up to 150 miles, and again, that it has been continually carrying on experiments which were quite necessary for the preliminary work before coming to the final design of a long-range station. Finally, their late commencement was determined by the fact that wooden masts and towers of the height and stability needed for large stations were not only very expensive, but also had not the requisite reliability of working. It was not until a type of antenna had been designed with which it was possible to use iron masts and towers without any loss of energy, could the German Wireless Telegraphy Company proceed with the erection of a high-power experimental station, which, especially with respect to the arrangement of the antenna, is entirely new and presents a considerable advance in the design of large stations.



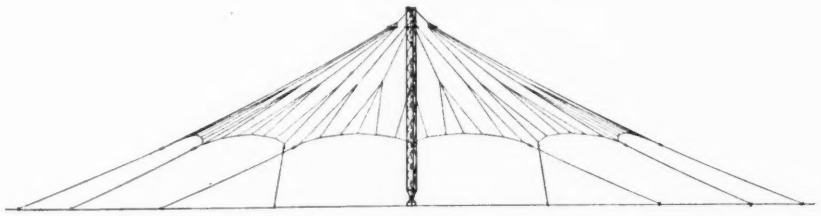
TRANSMITTING STATION, NAUEN WIRELESS TELEGRAPH PLANT.

The German Wireless Telegraphy Company has erected its station about twenty-four miles to the northwest of Berlin, near the small town of Nauen. Most interesting is the very high tower of iron trellis work about 330 feet in height which supports the antenna. The latter is formed of a great number of single wires. The Nauen station lies in the midst of a plain which extends in meadows, woods and ploughed fields for many miles around. The conditions of the soil are the most favorable which could be imagined for a radio-telegraph plant, seeing that water is reached at a depth of about six feet, and thus a very satisfactory ground connection is secured with little trouble. On the other hand the conditions were far from being favorable for building the high tower, seeing that the builders had to secure a solid foundation for the great weight of the tower and for the resulting tensional strains. The work was carried out very satisfactorily by the firm of H. Lehmann & Company, of Reinickendorf.

As regards the outside construction of the Nauen plant, this may be divided into three main parts; namely, the tower, the antenna and the earthing; and the sta-

tion building placed at the foot of the tower (see illustrations). The tower, which is 100 metres in height, is carried out in iron construction and has a triangular section with about four metres length on each side. The three side-beams are formed of riveted sections of eight metres length, bolted together, and are connected with each other by means of diagonal cross-braces. From the top of the tower, these beams come to within six metres of the ground. At the foot, the three beams are joined in a cast-steel sphere which rests upon a socket, and the latter is built as a sole plate for the tower. The immense pressure is carried through a layer of insulation to the concrete foundation. The tower can be easily mounted by means of an iron staircase, and at the top it is provided with a platform at a height of ninety-six metres. From this point the three pairs of pulleys for the hoisting of the antenna which are arranged at the top of the tower may be manipulated and controlled. A set of guy ropes for holding the tower are attached at the height of seventy-five metres, and they serve to maintain the whole tower in place. These guys are formed by a set of round iron stays, several metres in length, which are connected by massive links, and they lead with a considerable sag to the anchor points, which are about 200 metres from the foot of the tower. At the top and bottom, the guys are insulated from the tower and the anchoring. On account of the high-tension, sometimes reaching a 1,000-millimetre spark-length, the three upper insulators are of a special oil pattern and has stood the tests very well. The lower anchoring of these guys is carried out by means of masses of masonry which are built almost entirely above ground, and their great weight is enough to give the needed anchoring. In the engraving these weights can be observed like small houses with sloping roofs.

The antenna spreads itself out from the top of the tower and reaches the ground at a wide angle, but the wires are too fine to be shown in the photograph. In one of the illustrations herewith will be seen a diagram of this arrangement. The antenna is constructed as a sixfold umbrella antenna, and is so arranged that two opposite segments counterbalance one another by means of the pairs of pulleys above mentioned. By means of this arrangement, which is patented, the tower is subjected to a minimum of strain, and any strain which acts on one side of the tower is equalized. However, it is possible to lower any one of the six segments, for which purpose a special release apparatus is provided at the top of the tower.



THE MAST AND UMBRELLA ANTENNÆ, NAUEN WIRELESS TELEGRAPH PLANT.

The umbrella antenna consists, in the upper part of fifty-four phosphor-bronze cables, and towards the bottom the number is increased to 162 cables in such a way that every cable, at one-fourth of its length, branches out from a knot into two fresh cables. The total surface of the antenna is about 60,000 square metres. Each of the segments is connected by means of hemp cord and porcelain nut-insulators to a channel-iron post fixed solidly in the ground. From the top of the tower proceed the wires going into the station house and these consist of 154 cables in the form of six grids, held together by wood cross-pieces. These are carried down the tower and thus into the station. The leads are not insulated from the tower, so that the latter forms part of the oscillating system.

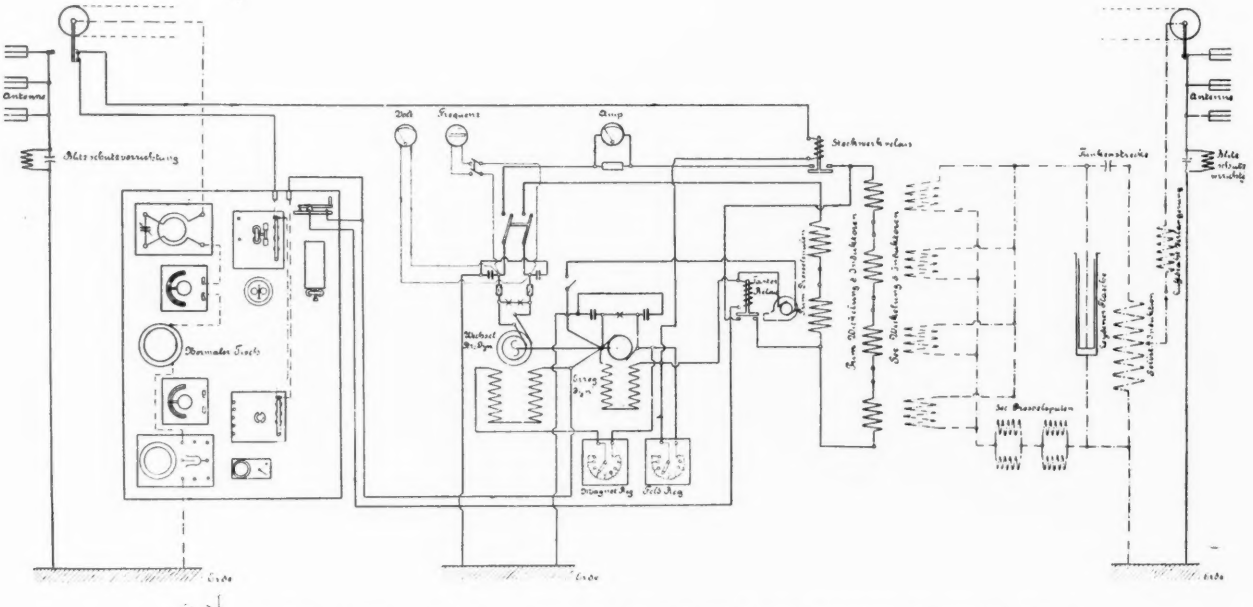
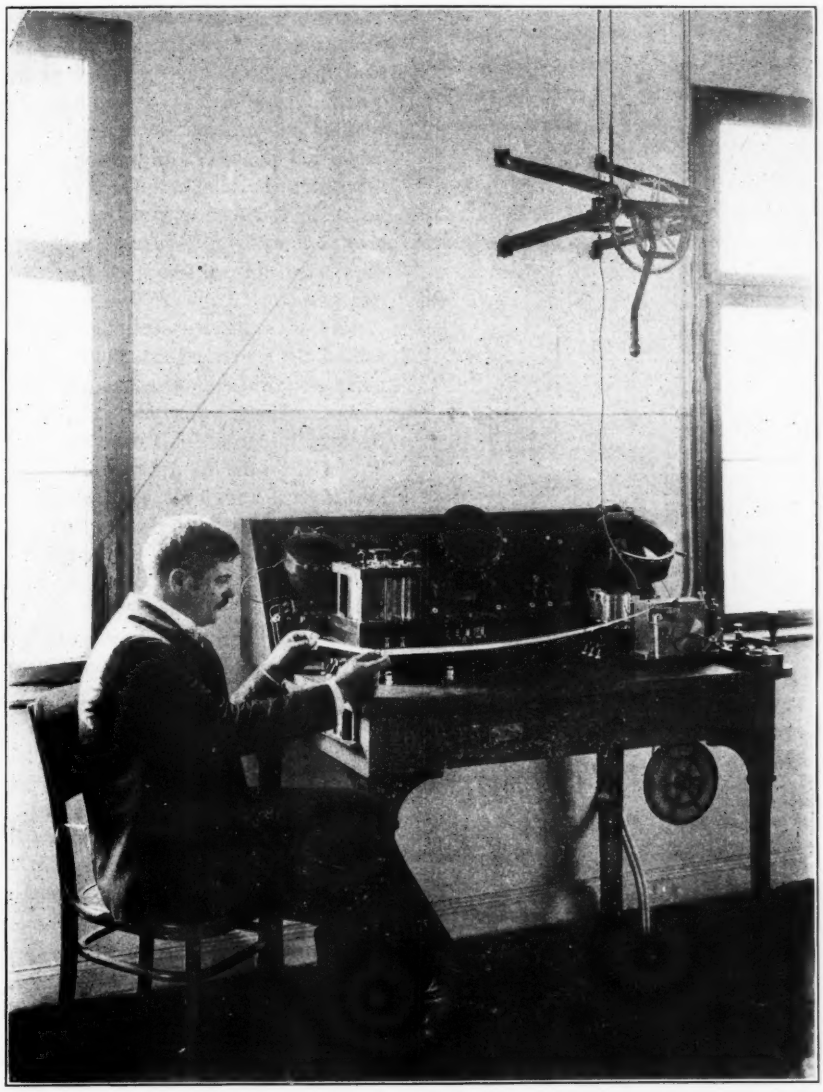


DIAGRAM OF CONNECTIONS AND ARRANGEMENT OF APPARATUS, NAUEN WIRELESS TELEGRAPH PLANT.

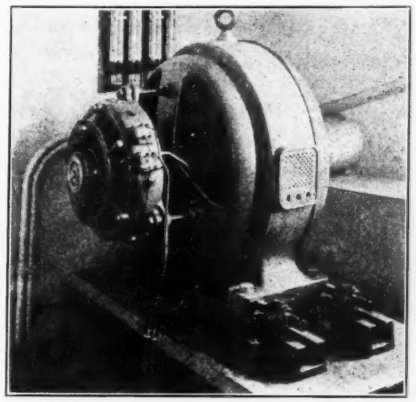
As regards the earth connection, this consists of 108 iron wires arranged fanwise in the earth, and they spread in the same manner as the above wires in umbrella form and make a network of 324 wires. The earth wires extend over a space of about 126,000 square metres. At the centre they join together and are led from this junction into the station.

The station itself is a two-story frame building covering about 100 square metres surface, and it has an engine shed adjoining. The rooms are so divided that the machine room, telegraph room and sleeping room are on the ground floor. On the upper floor is placed the high-tension room. This arrangement has in the first place the advantage of cutting off the sound of the sparking from the lower telegraph room, and above all it gives a dry position and a straight arrangement of the high-tension apparatus. The rooms of the station are heated by the exhaust of the engine and lighted by incandescent methyl spirit lights.



Receiving Station, Nauen Wireless Telegraph Plant.

As to the internal equipment of the station building, it may be divided into three parts: first, the power supply; second, the transmitter, and third, the receiver. The source of power is a portable engine of the usual kind which has a capacity of about thirty-six horse-power, using seven atmospheres pressure, and it operates at 120 revolutions per minute. Coal and coke are used as fuel. The water supply is given by a pump, which draws directly from the ground water. During the normal working of the plant, the engine is kept at one-quarter steam pressure during long pauses in the transmission, so that the fuel consumption is reduced to a minimum. At this pressure it is possible to transmit a brief response to the telegrams. As soon as the longer period of transmitting occurs it is possible, by means of the engine plant, to obtain full pressure in a few minutes, and then to carry on the full service. By this means the method of working with the portable engine is very simple and economical. A single-phase alternator is driven by belt from the flywheel of the engine, and this machine carries a small exciter mounted on the end of the shaft. The capacity of the alternator is about twenty-five kilowatts when running at the standard rate of 750 revolutions per minute and fifty cycles. The alternator windings are protected from the high-tension by means of safety cutouts. Cables pass from the machine to the switchboard, which is placed in the telegraph room. The following fuses, switches and measuring instruments are here arranged, as may be seen in the diagram of connections, and these include one double-pole switch, with fuses; one ammeter; one voltmeter; one frequency meter; one transmitting relay, and an automatic cutout. In the alternating-current circuit of the machine is placed a set of four choke-coils, and the circuits then lead to four induction coils which are installed with the rest of the high-tension apparatus on the second floor.



Alternating-Current Generator and Exciter

The Mast, Nauen Wireless Telegraph Plant.

The transmitting circuit consists of a capacity of 360 large Leyden jars, which are disposed in a triple series. A ring-shaped spark-gap is used, without ventilation, with a self-induction, consisting of a spiral of silver-plated copper tubing with connections for the exciting circuit and for coupling the air-wire and for connecting the earth wire, as is shown in the diagram. A permanent connection to the wave-meter allows of determining at any moment the length of the wave which is generated. The Leyden jars are charged from the secondary winding of the induction coils, with which are connected four high-tension choke-coils. By means of exact resonance, this large capacity can be charged with the expenditure of comparatively little energy. The cutting off of the induction coils from the Leyden jar battery is not carried out, as in small stations, by interrupting the primary circuit, but by short-circuiting the primary winding of the induction coils and at the same time the winding of the alternator through the above-mentioned choke-coils. On the other hand, the Leyden battery is charged by breaking this short-circuit. Seeing that very powerful currents are employed, a special design of switch was necessary, and this is provided in the present form of transmitting relay. This apparatus has proved very effective, not only as concerns reliability, but also as to the speed of telegraphing which can be attained. The transmitting relay is operated by means of an ordinary Morse key, which is placed on the receiving table of the telegraph room. The change over from transmitting to receiving is carried out in one movement by operating a switch, which throws the air-wire and ground circuit from the transmitting circuit to the receiving circuit, and at the same time disconnects the alternating-current circuit by means of a cutout, so that all possibility of transmitting is prevented. This arrangement is found to be quite essential in order to protect the sensitive cells and detectors from the influence of the exciting circuit.

All the receiving apparatus, as well as the condensers and coils needed for tuning the receiving circuit, are erected on one table which stands in the telegraph room. This table has a raised desk-like back, on which a part of the auxiliary apparatus is placed. By this means the table is made easier to manipulate and the scheme of connections is better understood. In the present arrangement of the receiver it is possible to receive with both the hearing and the writing receiver independently and also simultaneously. In order to protect the apparatus from atmospheric disturbances, a lightning arrester is provided which has proved very reliable, and it has been given a severe proof, seeing that lightning has struck the tower a number of times.

As regards the results which have been obtained up to the present with the above plant, we may cite some of the longest distances to which messages were sent recently. The longest distance as yet covered is with the hearing receiver on board the steamship Bremen, on the voyage to New York, this distance being about 1,500 miles, chiefly overland. In the second place we may cite a connection which was made overland at a distance of 840 miles with a hearing receiver at St. Petersburg. With the hearing and also with the writing receiver, connection was made with the station on the Rigi Scheidegg, Switzerland, chiefly over mountains in this case. The working of the Nauen plant as above described has proved to be very simple and economical. It can be carried on by two men; namely, one stoker, who also does any other heavy work in the station and one expert telegraph operator.

Municipal Ownership and the American Street and Interurban Railway Association.

At the 1906 convention of the American Street and Interurban Railway Association, held at Columbus, Ohio, a committee presented a report on the subject of municipal ownership. The same committee was continued for this year, and another report on the same subject will be presented at the Atlantic City convention, to be held in October next. It is likely that this report will not discuss the question from an academic point of view, as the literature on the subject has been greatly multiplied during the past year. It is desirable, however, that the report should cover any progress made either for or against the movement. A series of questions is being submitted to the general managers of street and interurban railway properties in America.

The Committee on Municipal Ownership consists of Charles D. Wyman, chairman, Boston, Mass.; John A. Beeler, Denver, Col.; H. M. Sloan, Chicago, Ill., and J. J. Stanley, Cleveland, Ohio.

The Western Pennsylvania Exposition.

The Western Pennsylvania Exposition was opened at Pittsburg on the evening of August 28. This is said to be the largest permanent industrial exposition in America, and is to be open continuously for ninety days.

A comprehensive showing of manufactured machinery and equipments is made, covering the various mechanical and electrical lines, and many interesting industrial developments are given practical demonstration here. The buildings occupied cover a large area, and are well adapted in construction and location for exhibition purposes. The interest in the exposition is to be aided by excellent music in the Auditorium by the best orchestra, and as Pittsburg is a music-loving centre, this will be a great attraction in itself.

Among the electrical companies making exhibits of electrical machinery and apparatus are the following:

Westinghouse Electric and Manufacturing Company. This company shows a line of its standard dynamos and motors, switchboard apparatus, electrical measuring instruments and other equipments especially applicable for use in building construction, mines and manufacturing plants.

Felix Hamburger, of New York, manufacturer of arc lamps, has a complete exhibition of the various types of flaming arc lamps.

The Crocker-Wheeler Company, Ampere, N. J., exhibits a line of its smaller dynamos and motors.

The Dearborn Drug and Chemical Company, Chicago, has a large exhibit, well displaying its products for purifving water for steam boilers.

Ludwig Hommel & Company, Pittsburg, manufacturer's agent, has an exhibit covering the following lines:

Sangamo Electric Company, electric meters.

General Storage Battery Company, storage batteries.

American Instrument Company, electrical measuring instruments.

Switchboard Equipment Company, circuit-breakers.

Bristol Company, electrical measuring instruments.

Mica Manufacturing Company, sheet mica, tubes, bushings, etc.

Schwarze Electric Company, electric bells for railroad crossings.

American Arc Lamp Company, enclosed arc lamps.

A NEW METHOD FOR LOCATING FAULTS IN ELECTRICAL DISTRIBUTING SYSTEMS.[1]

BY F. SCHULTZ.

It is, of course, of great importance for all electrical supply systems to be able to locate quickly and accurately, and in a simple way, any disturbance occurring on their cable systems. In Berlin the supply company has been using for some time past a system patented in 1893, in which troubles in the electrical cables are automatically indicated by means of test wires. The principle consists in running a test wire in the cable itself, so that if a fault occurs in the cable a short-circuit is made between the latter and its test wire, which cuts out a resistance at the far end of the cable, and thus causes a deflection of the voltmeter placed at the station end, which thus indicates the cable on which the fault has occurred. For indicating cable troubles in distributing cables the same method may be used, the test wires being then connected in parallel to the corresponding test wire of the feeding cable.

If the disturbances take place in the house wires, however, this system fails, since house wires are not provided with test wires. And yet, such faults are likely to occur if the distributing cabinet be placed in a damp, dark cellar, as is often done. Such arrangements frequently give rise to very severe cable troubles.

There are a number of interruptions which may occur, not due to a fault in the cable itself. For example: the fuse on the feeding cable burns out possibly because the proper size of fuse has been forgotten, or perhaps due to heating from a bad contact. The feeder thus is thrown out of service, so that the distributing system must be supplied from another cable, which thus becomes overloaded and its fuse is burned. In this way, in a very short time, an entire system may be thrown out of service. In a similar way, if at some feeding point a riser, either due to an earth or a short-circuit, causes the burning-out of the feeding cable's fuse, a whole section of the system may be thrown out of service. In both cases it is of the greatest importance to locate quickly the burned-out fuses. The author's many years' experience has taught him that cable failures usually cause the burning out of one or more fuses in a distributing system, and a method which will enable the central station to locate quickly and accurately the burned-out fuses should be of very great assistance.

For the solution of this problem a method has been devised by the author, the principle of which is to connect the test wire to its cable by means of a fine loop of wire carried close under the fuses of the distributing cables. The arc produced by the burning out of any fuse then breaks this test wire loop, disconnecting the test wire from the feeding cable and thus rendering it dead. A voltmeter connected to the test wire at the station would then show where the fuse had given out. For this purpose the station voltmeter may be used, if provided with a suitable switch for connecting it to the various test wires of the system. The system may also be used for high-potential systems by utilizing the elasticity of the loop of wire for making contact through a relay, thus giving the signal of the burning of the fuse. The system may be employed with enclosed fuses, either by passing the loop of fine wire through holes in the side of the fuse case, or by carrying it through the case parallel to the fuse wire. In either method the burning out of the fuse will break the test wire loop and thus open the circuit.

The great advantage of the system is its simplicity, nothing being required to introduce it on those systems provided with test wires except the fine wire connecting the loop. The usual indicating voltmeter and switches may be employed for this purpose.

The system has been used by the Allgemeine Elektricitäts Gesellschaft on the distributing system in Münster, in Westphalia, Germany, since February, 1906. During this period it has operated many times, and has not failed to indicate the burning-out of a fuse.

[1] Abstracted from the *Elektrotechnische Zeitschrift*.

General Electric Company of California.

A certificate of an increase of bonded indebtedness of the General Electric Company of California has been filed, together with a deed of trust to the Carnegie Trust Company, which latter organization has secured a mortgage on the property of the electric company for the sum of $9,000,000. This amount is stated to be required for the development of the company's properties for the transmission of electric power, and also for the purpose of completing the Clear Lake & Southern Railroad Company's line. The bonds are payable in gold, maturing in thirty years, and bear interest at the rate of five per cent per annum.

Report of the British Association Committee on Practical Standards for Electrical Measurements.[1]

The main work during the year has been the completion of the work with the ampere balance. The general results are referred to in some detail below. The final measurements confirm the opinion expressed in last year's report that an accuracy of a few parts in 100,000 might be reached. It appears that the result is probably accurate to one in 50,000. Interim reports on the ampere balance, indicating the progress of construction, adjustment and use of the instrument, have been submitted to the association since 1904.

The committee is now pleased to report that the balance continues to give complete satisfaction. During the past year it has been much used for determining the electromotive force of the normal Weston cadmium cell and the electrochemical equivalent of silver. A description of the instrument, its construction and adjustment, and the results obtained with it in the cadmium cell determinations, has been prepared and submitted to the Royal Society for publication in its transactions by Professor Ayrton, Mr. Mather and F. E. Smith. An account of the work on the electrochemical equivalent of silver is well advanced and will be published shortly.

In all some seventy-one observations have been made on a certain cadmium cell (No. 2), using both sets of coils on the balance, and thirteen observations in which one or the other of the two sets was employed. The agreement between the individual results obtained with the two sets of coils is remarkable, the average difference from the mean amounting only to six parts in 1,000,000. The whole series of observations extended over a period of nineteen months (September, 1905, to April, 1907), and during that time the coils of the balance were reset five times. No determination made has been omitted, except those in which the observations were of such a nature that a decision to disregard the result was arrived at before its computation. Such occasions were rare.

Of the seventy-one observations made, seven are within one, fourteen are within two, twenty-eight are within five, fifty-

[1] This report was issued during the meeting at Leicester. The committee consists of Lord Rayleigh (chairman), Dr. R. T. Glazebrook (secretary), Lord Kelvin, Professors W. Ayrton, J. Perry, W. G. Adams and G. Carey Foster, Sir Oliver J. Lodge, Dr. A. Muirhead, Sir W. H. Preece, Professors A. Schuster, J. A. Fleming and J. J. Thomson, Dr. W. N. Shaw, Dr. J. T. Bottomley, Rev. T. C. Fitzpatrick, Dr. G. Johnstone Stoney, Professors S. P. Thompson, J. Rennie, Principal E. H. Griffiths, Sir A. W. Rucker, Professors H. L. Callendar and George Matthey.

three are within ten, sixty-six are within fifteen, and seventy are within twenty in a million of the mean. Only one determination out of the whole seventy-one, and this one of the earliest, differs from the mean by so much as one part in 59,000. The above facts constitute important evidence of constancy in both balance and cell. In fact, both current weigher and cell proved to be much more constant and reliable than the standard resistance, although the latter was very carefully made and annealed with a view to insuring permanency.

Expressed in terms of the international ohm, as realized at the National Physical Laboratory, and of the ampere as given by the new current weigher, we find that the value of $C \times R$ for the normal Weston cadmium cell is 1.01830_5 at seventeen degrees centigrade. This assumes that the value of g at Teddington is 981.19, a number probably correct to within three parts in 100,000. An uncertainty of this amount in g introduces a possible error of one and one-half parts in 100,000 in the value of the ampere, and, as all other probable errors are smaller in magnitude, it is important that a more accurate determination of g be made.

To realize the volt with an accuracy approaching that of the ampere, as now known, it is necessary that an absolute determination of resistance of corresponding precision be undertaken. Through the kindness of the Drapers' Company, of London, it is hoped that such a determination by means of a Lorenz apparatus may be completed at the National Physical Laboratory before the end of next year. At the present time the uncertainty in the absolute value of the international ohm approximates to four in 10,000. From the above value of $C \times R$ for the cadmium cell together with the ratio of Clark to cadmium—*viz.*,

$$\frac{\text{Clark at } 15^\circ\text{C.}}{\text{Cadmium at } 17^\circ\text{C.}} = 1.406_6,$$

the electromotive force of the Clark cell at fifteen degrees centigrade becomes 1.432_3.

The committee recognizes very fully the skill and devotion of Mr. Mather and Mr. Smith, on whom the work of carrying out the experiments has fallen, and has invited these gentlemen to become members of the committee. Papers by F. E. Smith, of the National Physical Laboratory, dealing with the use of the silver voltmeter and the preparation of the Weston cadmium cell, are nearly ready for publication. Some preliminary work has also been done on the design for the Lorenz apparatus, the funds for which are being found by the Drapers' Company. The proposed design embodies new features of importance.

With regard to the proposed conference on electric units, further consideration led to the conclusion that a year's delay was desirable, and, in consequence, the meeting was postponed from October, 1906, to October, 1907. With a view to a preliminary agreement on the matters to be raised, correspondence has passed during the year between the secretary, acting as director of the National Physical Laboratory, and the heads of standardizing laboratories in other countries. The conference will probably deal with the drawing up of an international convention relative to electric units, which should include the draft of a form of law which might be adopted generally in the various countries represented, and the consideration of the steps necessary to secure uniformity in the carrying out of the laws in different countries, and to arrange for determinations necessary for this purpose. The necessary invitations for the conference are being issued by the British government.

To secure uniformity in carrying out the law it will be necessary that specifications for constructing and using a mercury unit of resistance, for setting up and working a silver voltmeter, and for preparing a standard cell, be approved either by the conference itself or by somebody nominated by the conference for this purpose. With a view to aiding discussion, very detailed specifications dealing with the voltmeter and the cell have been prepared by the National Physical Laboratory and issued to other standardizing institutions. It is not suggested that the final specifications need be so full or to be detailed, but it was thought well that all information necessary to assist in criticizing the results should be included.

The work on the silver voltmeter and Weston cell still continues, and, in view of the deliberations of the conference, it is probable that further expenditure will be required. The accounts show that a balance of 10*s.* 8*d.* remains from the grant of £50 made last year. The grant has been spent on the purchase of material and appliances for the research.

In view of the importance of bringing the work of redetermining the values of the fundamental units to a satisfactory conclusion, the committee recommends that it be reappointed, with a grant of £50, and with the addition of the names of A. P. Trotter, T. Mather and F. E. Smith, that Lord Rayleigh be chairman and Dr. Glazebrook secretary.

THE MICHIGAN ELECTRIC ASSOCIATION.

CONVENTION HELD AT BATTLE CREEK, MICH., AUGUST 20-22.

The fourth annual convention of the Michigan Electric Association was held at Battle Creek, Mich., August 20, 21 and 22. Headquarters were established at the Tavern. The business sessions were held in the rooms of the Business Men's Association, the opening session being called to order at 10 A. M. Tuesday, August 20. William Chandler, Sault Ste. Marie, president of the association, was in the chair.

The convention was addressed by Mayor Green, who extended a cordial welcome to the city. President Chandler then gave a short talk, in which he outlined the policy of the association and discussed certain pertinent matters. The morning session was concluded by the reading of a complete report presented by the Insurance Committee.

The afternoon session included the reading of papers as follows: "A Year's Operation at the Highest Voltage in the World—the Grand Rapids-Muskegon Power Company," by J. B. Foote, of Jackson; "Steam Turbines for Central Station Service, Especially in Small Units," by H. A. Fee.

On Wednesday morning the first business was the reading of a paper by President Chandler, on "Some Actual Experience with Tungsten Lamps at Sault Ste. Marie." This was followed by a paper entitled "Prepayment Wattmeters," by E. A. Harris, of the Westinghouse Electric and Manufacturing Company.

In the afternoon a paper was read by J. B. Foote, entitled "Recent Developments in Lamps as Applied to Street Lighting." This was followed by a paper entitled "Factory Lighting," by A. P. Biggs.

On Thursday morning the session was opened with a paper by H. B. Gunnison, entitled "The Operation of Centrifugal Pumps at Grosse Pointe Waterworks." A symposium entitled "Results of New-Business Campaigns in Various Cities," was presented by R. W. Hemphill, Jr., Ann Arbor; Lawrence Manning, Owosso, and A. E. Palmer, Kalkaska.

In the afternoon a paper entitled "Accounting for Small Stations" was presented by F. A. Beard, and the report of the Insurance Committee was discussed. After this discussion officers were elected, as follows: president, H. W. Hillman, Grand Rapids; vice-president, J. A. Cavanaugh, Benton Harbor; secretary and treasurer, A. C. Marshall, Port Huron; executive committee: A. E. Palmer, Kalkaska; W. P. Stevens, Kalamazoo; finance committee: L. B. Schneider, D. D. Dodge and A. G. Noble.

ON THE MOTIONS OF ETHER PRODUCED BY COLLISIONS OF ATOMS OR MOLECULES CONTAINING OR NOT CONTAINING ELECTRIONS.[1]

BY LORD KELVIN.

1. By atom is meant an indivisible element of ponderable (gravitational) matter, or of electricity; by molecule, an assemblage of two or more ponderable atoms, held together by mutual attractions balanced by mutual repulsions.

2. In the atomic theory of electricity, electrion means an atom of resinous electricity, commonly hitherto called negative electricity. It is at present commonly assumed, and I believe in all probability rightly assumed, that all electrions are equal and similar.

3. An ancient hypothesis, which has had large consideration among philosophers in all times, assumes that there is only one kind of atom, and that groups of equal and similar atoms constitute the chemical elements with all their marvelous variety of quality. But, though no doubt some important and interesting differences of quality, such as the difference between ordinary and red phosphorus, are due to differences of grouping in assemblages of one kind of atom, it seems extremely improbable that differences of grouping of atoms all equal and similar suffice to explain all the different chemical and other properties of the great number of substances now commonly called chemical elements. It seems, indeed, almost absolutely certain that there are many different kinds of atom, each eternally invariable in its own specific quality, and that different substances, such as gold, silver, lead, iron, copper, oxygen, nitrogen, hydrogen, consist each of them of atoms of one invariable quality and that every one of them is incapable of being transmuted into any other.

4. The sole properties of an atom are: (1) its mass (being the measure of the inertia of its translatory motion), (2) its law of mutual force between itself and every other gravitational or electrical atom in the universe, varying according to the distance between them. As to the mutual force between ponderable atoms, we have strong reason to believe that this law practically is the Newtonian law of universal gravitation for all distances exceeding the millionth of a centimetre. For distances considerably less than the millionth of a centimetre, the Newtonian law of attraction, according to the inverse square of distance merges into repulsions resulting in mutual pressure of two bodies resisting joint occupation of space. For smaller distances we have attraction again, in the inevitable theory of Boscovich, constituting cohesions and chemical affinities.

5. The assumption that the mutual force between two atoms depends merely on the distance between their centres implies that each atom is utterly isotropic. An aeolotropic atom, that is to say, an atom having different attractive and repulsive forces in different directions, is conceivable, and may possibly come in future to have a place in atomic theory. Hitherto it has been universally assumed that every atom, whether gravitational or electrical, is thoroughly isotropic, and I do not propose at present to enter upon any theoretical consideration of aeolotropic atoms.

6. I do not propose to enter on any atomic theory of ether. It seems to me, indeed, most probable that in reality ether is structureless, which means that every portion of ether, however small, has the same elastic properties as any portion, however great. There is no difficulty in this conception of an utterly homogeneous elastic solid, occupying the whole of space from infinity to infinity in every direction. We sometimes hear the "luminiferous ether" spoken of as a fluid. More than thirty years ago I abandoned, for reasons which seem to me thoroughly cogent, the idea that ether is a fluid presenting appearances of elasticity due to motion, as in collisions between Helmholtz vortex rings. Abandoning this idea, we are driven to the conclusion that ether is an elastic solid, capable of equi-voluminal waves, in which the motive force is elastic resistance against change of shape.

7. We now meet the question: Is ether incompressible? We should be compelled to answer: Yes, it is incompressible, if it is subject to the law of universal gravitation. But presently, when we try to account for motion produced in ether by ponderable or electrical atoms moving through it, we shall feel ourselves persuaded that ether is compressible.[1] Believing this, we are forced to believe that it is non-gravitational. Thus we find ourselves settled in the conviction that ether is compressible, and that ether experiences no gravitational forces between its parts.

8. Suppose now that an atom, whether ponderable or electrical, disturbs ether solely by attracting it or repelling it with a force varying according to distance; and that with no other mutual influence than this, the atom and the ether jointly occupy the same space. If ether were incompressible, this attraction or repulsion would be utterly ineffective; and the atom would move through the space occupied by the ether, without giving any motion to the ether, and without itself experiencing any influence of force due to the ether. Hence, in order that atoms may take energy from motions of ether, and that ether may take energy from motions of matter, we must suppose the ether to be compressible and dilatable; and to be compressed or to be dilated, or compressed at some distances and dilated at other distances, in virtue of the force exerted on it by the atom.

9. While assuming ether to be compressible, we suppose its resistance to compression (positive or negative) to be so very great that the velocity of condensational refractional waves in pure ether is practically infinite, and that the energy of whatever of such waves may be produced by collisions of atoms or electrons is practically nil in comparison with the energy of the equi-voluminal waves, constituting radiant heat and light, which are actually produced by those collisions. It is only under the enormous forces of attraction or repulsion exerted by atoms on ether that augmentation or diminution of its density is practically influential.

10. By purely dynamical reasoning, it may be proved to follow from the hypotheses of sections 4, 6, 8 and 9, that an atom (supposed for a moment to be infinitely small) kept moving through ether at any velocity, q, greater than v, the velocity of light, produces no disturbance in the ether in front of a cone having its vertex at the atom, and semi-vertical angle equal to $\sin^{-1}\frac{v}{q}$;[1] but that the moving atom produces, in its rear wholly within the cone, an ever-growing disturbance of ether, and therefore requires the application of a continual pull forward to keep it moving uniformly at any constant velocity exceeding the velocity of light. In 1888, Oliver Heaviside[2] arrived at a corresponding conclusion by purely mathematical work, from Maxwell's electromagnetic formulas, without any dynamical foundation; and in 1897,[3] still without assuming any dynamical or chemical properties of ether and atoms, he corrected an erroneous hypothesis, that no force, however great, could give an atom a velocity equal to the velocity of light, which has been somewhat exten-

[1] Read before Section A of the British Association, at Leicester, August 1, 1907.

[1] "Baltimore Lectures," Appendix A; Appendix B, Section 3.

[1] "Baltimore Lectures," Appendix B, Sections 6 and 7.

[2] Heaviside's "Electrical Papers," Vol. II, pp. 494, 516.

[3] Heaviside's "Electromagnetic Theory," Vol. II, Appendix G.

sively adopted within the last ten years in speculations and reckonings regarding radioactivity.

11. Purely dynamical reasoning[1] on our physical assumptions of sections 4, 6, 8 and 9, teaches us further that:

(*a*) No force is required to keep an atom moving uniformly through ether at any velocity less than the velocity of light.

(*b*) To start an atom suddenly into motion from rest, causes a spherical pulse to travel outwards with the velocity of light, from the place in which the atom was when it was receiving the supposed velocity.

(*c*) The magnitude of this spherical pulse is a maximum in the plane through the centre perpendicular to the line of motion, and is zero at the two points in which the spherical surface is cut by that line.[2]

(*d*) This spherical pulse carries outwards through infinite space a finite quantity of energy, l, due to a part of the work, w, done by the force which was applied to the atom to start it in motion. The sharper the suddenness the greater is l.

(*e*) If at any time a resisting force suddenly stops the atom, work is done on the ether, in virtue of which another pulse carries away an amount of energy l'; and work is done on the stopping agent amounting to $w - l - l'$.

(*f*) If the suddenness of the stopping is equal and similar to the suddenness of the starting, the second pulse is equal and similar to the first, and l' is equal to l.

12. To understand clearly the meaning of (*e*) take an example. Let three equal and similar electrionless atoms, A, B, C, be given in a straight line, A moving with velocity q toward B, and C moving toward B in the contrary direction with a velocity just so much less than q that B is left at rest after its collision with C. The initial distances are such that the collision between A and B precedes the collision between B and C. Amounts of energy equal to l and l' are carried away into infinite space in the pulses produced by the two collisions. In the arrangement now described, the suddennesses of the starting and stopping of B are not precisely equal and similar; and because of their difference l' would generally be somewhat less than l; but the law of force between the atoms might be such as to render l' equal to or greater than l, for certain ranges of values of q.

Take an analogous case of collisions between three ideal billiard balls, each perfectly elastic. The clicks of A on B, and of B on C, cause losses of energy, l, and l', carried off through air by sound-waves.

13. Consider now the collisions in a non-electrified monatomic gas; that is to say, an assemblage of single atoms, each having within it its neutralizing quantum of electrions, except a small proportion from which the electrions may have been temporarily knocked out. For simplicity, we shall first take the case in which a single electrion is the electric neutralizing quantum for each ponderable atom. The collisions will keep the electrions continually in a state of vibration within the atoms, except in the comparatively rare case of an electrion knocked out of an atom, or in the infinitely rare case of the relative motion of an atom and electrion being reduced exactly to zero by a collision.

14. The law of force between the electrion and atom may be such that the centre of the atom is the only position of stable equilibrium for an electrion within it.

15. Or the law of force may be such that there are any number, i, of concentric spherical surfaces within the atom, on each of which an electrion may rest in equilibrium radially stable; and $i - 1$ intermediate surfaces, on each of which an electrion would be in equilibrium radially unstable.[1] In the statistical average of collisions, the electrion may, immediately after a particular collision, be ranging in non-sinusoidal vibration, through several spherical surfaces of stable and unstable equilibrium, losing energy by sending out irregularly reciprocating waves through ether. Before the next collision, the electrion may probably have settled down into very approximately sinusoidal vibrations in and out on each side of any one of the surfaces of radial stability.

16. This last condition we may suppose to be generally prevalent during the greater part of the free path between successive collisions. We may, indeed, suppose it to be more frequently the immediate result of a collision than the wilder vibration described in section 15, which, however, must undoubtedly be an occasional, though probably a rare, condition, immediately after a collision.

17. We are not bound to assume that a single electrion is the saturating quantum of any particular ponderable atom; nor are we bound to suppose that it is electrically neutralized by any integral number of electrions.[2] The most general supposition we can make is that, with j electrions, the atom and electrions act externally as a vitreously electrified body, and, with $j+1$ electrions, the atom and electrions act as a resinously electrified body.

18. It seems to me exceedingly probable that the persistence of the two-atom molecule in the common diatomic gases O_2, N_2, H_2, Cl_2, is due to the impossibility of electrically neutralizing the ponderable atom by any integral number of electrions. Suppose, for example, that one electrion suffices to neutralize electrically two atoms of nitrogen. A monatomic nitrogen gas (N), if non-electrified as a whole, would have half of its atoms without electrions, and, therefore, vitreously electric, with electric quantity equal and opposite to half that of a single electrion. Each of the other half of its whole number of atoms would have one electrion within it, and, therefore, its external action would be resinous, with half the potency of a single electrion. Thus, there would be a strong electric attraction between the atoms destitute of electrions and the atoms each containing one electrion within it. This attraction would tend to bring the atoms together in pairs, N_2, each pair containing one electrion of which one position of stable equilibrium would be at the middle of the line joining the centres of the two ponderable atoms. It seems quite probable that this is the real condition of ponderable atoms and electrions, in the ordinary diatomic gases.

19. The dissociation of a considerable number of such pairs of atoms would be exactly the "ionization" by which, following Schuster's and J. J. Thomson's theory of the conduction of electricity through gases, the latest developed theories of radioactivity explain the specially induced electric conductivity of diatomic gases, such as Lenard found to be produced in air by ultra-violet light traversing it, and Becquerel found in air all round an apparently inert piece of metallic uranium, or a uranium salt.

20. But, to give electric conductivity to a monatomic gas, the "ionization" could not be anything else than dissociation of electrions from ponderable atoms. This kind of dissociation might be produced in a very hot gas by mere impacts between the atoms of the gas itself, with the large translational velocities to which high temperatures are due. Or it might be produced by extraneous bodies, such as the "α" or "β" particles shot out with high velocities from radioactive substances. We are now, however, chiefly concerned with the motions of ether produced by

[1] "Baltimore Lectures," Appendix B, Sections 4 and 7.

[2] "Baltimore Lectures," Lec. VIII, p. 88; Lec. XIV, p. 197.

[1] "Plan of an Atom to Be Capable of Storing an Electrion with Enormous Energy for Radioactivity," by Lord Kelvin, *Phil. Mag.*, December, 1905.

[2] "Aepinus Atomized," Sections 5 and 6; "Baltimore Lectures," Appendix E.

collisions of atoms, in circumstances less abnormal than those in which dissociations and recombinations are largely influential.

21. The pulses described in sections 11 and 12, as due merely to mutual collisions between ponderable atoms (without consideration of electrions whether present or not), constitute a kind of motion in the ether which, if intense enough to produce visible light, would, when analyzed by the spectroscope, show a continuous spectrum without the bright lines which, when seen, prove the existence of long-continued trains of sinusoidal vibrations of particles of ether, in the eye perceiving them, and therefore also in the source, and in all the ether between the source and the eye. On the other hand, the vibrations of electrions referred to in section 13 would, if intense enough, produce bright lines in the spectrum.

22. There is another kind of vibration in the source which might produce, and which probably does produce, bright lines in the spectrum. If there are two or more ponderable atoms in the molecule of a glowing gas, not dissociated by the violence of the collisions, each atom of the molecule must have a vibratory motion, of which an isolated ponderable atom is incapable, and these vibratory motions of the atoms of a group must give rise to bright lines in the spectrum, when the frequency of the vibrations in any one, or in all, of the vibrating modes, is between 400 million million and 800 million million per second, if we take this as the range of frequencies for visible light.

23. The spectroscopic phenomena to be accounted for in a dynamical theory of light include continuous spectrums, with large numbers of bright lines superimposed on the more or less bright background of continuous spectrum. Even when every care has been taken, in artificial sources of light, to eliminate influence of more than one of the substances commonly called chemical elements, the number of bright lines is generally very large; indeed, we are not sure that we have been able to count the whole number of those which are presumably due to any single element.

24. In a glowing monatomic gas, with just one electrion to each atom, and only the central position of stable equilibrium for the electrion in the atom, there could be only one bright line in the spectrum. But, in reality, every one of the known monatomic gases—mercury-vapor, argon, helium, neon, krypton, xenon—gives a highly complicated spectrum with a large number of bright lines. We infer that, if there is just one electrion to each atom, it has many positions of stable equilibrium; or that there are many electrions, with only the central position of equilibrium for one of them alone; or that there are many electrions, and many stable positions for one of them alone in the atom.

25. It seems as if only by the third supposition—many electrions and many positions of stable equilibrium—we can imagine the great number of bright lines, and the great complexity of their arrangement in the spectrums of the monatomic gases.

26. But we feel little satisfaction in this or any other attempt to discover details of dynamical theory, unless it gives some reasonably acceptable explanation of the laws of arrangement of trains of bright lines in the spectrums of different chemical elements, which have been experimentally discovered by Runge, Kayser, Rydberg, Schuster, and others.

Calcium Nitrate as a Fertilizer.

The *Electrical Review*, London, quotes from a report upon the progress made by agricultural chemistry during the year 1906, contributed to the *Chemiker Zeitung* by Doctor Stutzer, that part discussing the properties of calcium nitrate as a fertilizer. He remarks that no large quantities of this salt have yet been placed on the markets, but now that the initial difficulties of manufacturing it electrically have been overcome in the Birkeland and Eyde process through the improvements effected by the Badische Anilin und Soda Fabrik, the material will doubtless soon be obtainable on a large scale. Hence it becomes of interest to compare the value of the new product with that of sodium nitrate or Chile saltpetre, both of which contain nitrogen in the form of nitrate, although their bases are different. According to the experiments carried out two years ago by Jermakow, it seems possible that some oxalic acid is formed in plants when nitric nitrogen reacts upon grape sugar. In certain circumstances free oxalic acid is harmful, and therefore there appears to be an advantage in having some calcium salt present to combine with it. Tests have indeed shown that the absorption of nitrates by plants is much more energetic in the presence of soluble calcium salts than in their absence, although as a rule this phenomenon is not of great practical importance, because the soil in which plants are cultivated generally contains a sufficient quantity of calcium. J. Sebelien has carried out comparative experiments upon the value of sodium nitrate and calcium nitrate in sandy and loamy soils with oats and carrots, finding the two fertilizers to be of about equal value. In soils deficient in lime, however, the calcium nitrate was naturally the more valuable of the two. Calcium nitrate also proved more valuable when applied to a certain crucifer, *e. g.*, white mustard, this result agreeing well with some older observations made by Wagner. W. Krüger has tried calcium nitrate in the cultivation of the sugar beet, and found it at least as valuable as Chile saltpetre. Belleloux had stated that calcium nitrate increases the proportion of starch in potatoes more than sodium nitrate, and Stutzer has also observed a good effect in the same case. The author remarks that the preparation of nitric acid from air and its employment in agriculture is of extremely great importance, so that laboratory and practical tests upon its value when applied to all plants cultivated for industrial purposes ought to be carried out for several years. This is the more desirable inasmuch as certain technical difficulties in the manufacture have been overcome. In the early days one of the defects of calcium nitrate was that a certain portion of the nitrogen was present in the form of nitrate. This compound was found in some experiments carried out by the author not to be harmful to established plants, but to do a considerable amount of damage during the germination of certain seeds. The calcium nitrate now manufactured in Norway is free from nitrite. Dr. Stutzer continues his article with several references to the value of calcium cyanamide, but does not appear to give much more information on this than has already been published by him and others.

South Australian Telegraphy.

The first line of telegraph established in South Australia, says *Engineering*, was opened in 1856, when thirty-six miles of wire were brought into operation. The number of telegrams forwarded during the year was 14,738 from seven stations, and the revenue collected was $1,830. In 1866, the length of wire stretched had increased to 1,565 miles, the number of telegrams forwarded to 121,153, the number of stations to fifty-eight, and the revenue to $62,065. In 1876, 4,486 miles of wire had been stretched, 374,144 messages were despatched from 112 stations, and the revenue collected was $179,235. In 1886, 10,310 miles of wire had been stretched; the number of telegrams forwarded from 200 stations was 669,442, and the revenue collected was $340,655. In 1896, the length of wire stretched had been carried to 14,280 miles, the number of telegrams forwarded from 254 stations was 1,209,419, and the revenue collected was $511,875. In 1905, the length of wire stretched was further carried to 20,737 miles, and the number of stations had increased to 299, the number of messages was 1,789,608, and the revenue was $435,125.

South Australia passed through difficult times during the last ten years, in consequence of extremely scanty rainfall and low prices for wool. The colony has, however, revived of late, and its telegraphic business has shown a sympathetic activity.

The Berkshire Power Company, of Canaan, Ct.

THE Berkshire Power Company was organized under the laws of the state of Connecticut late in the year 1904. Its purpose was the consolidation of the small struggling electric service corporations of the villages of northwestern Connecticut, so that from a central power-house modernly equipped, and under a common and aggressive management, a first-class electric service for both lighting and power might be economically rendered.

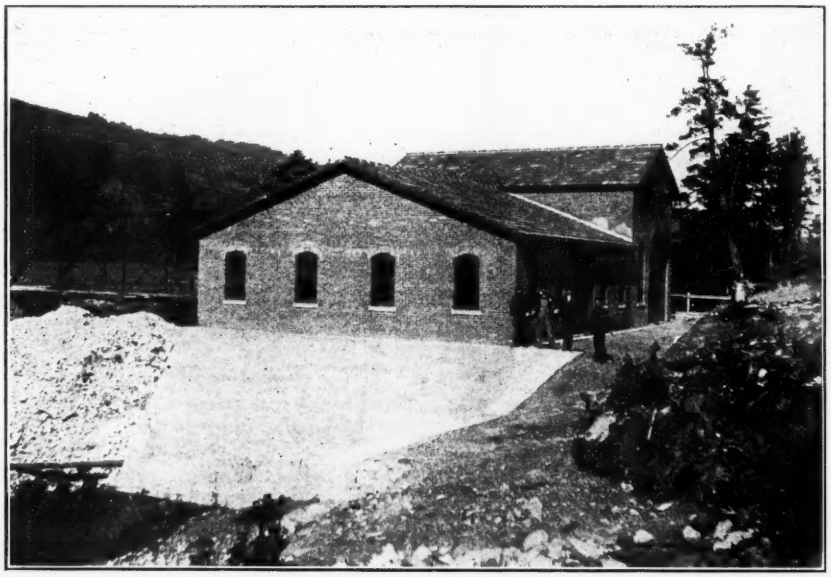
The project of furnishing such a class of service to widely scattered rural communities was somewhat novel, and unfortified by precedent, but the character and prosperity of the population, and the availability of a centrally located water power made probable a legitimate return on the investment.

Upon organization, the company immediately acquired the capital stock of the Norfolk Electric Light and Power Company, and began negotiations for the purchase of the Sharon Electric Light Company, which were consummated in April, 1905. With the ownership of these two companies, the Berkshire Power Company obtained charters and franchises allowing it to supply electricity throughout the towns of Norfolk, Canaan, North Canaan, Salisbury and Sharon, all located in that portion of the Berkshire Hills district of Connecticut which has become so popular as a summer residence for city people.

In late December, 1904, work was commenced on a dam and power-house on the Housatonic river at a point about one and one-half miles below the village of Canaan, and the work was so far completed that in the following September current was supplied to the lines of the old Norfolk company. It was not, however, until the winter of 1906 that the transmission line to Sharon was finally connected and the complete territory served from the new central power-house. Now, however, something over a year's experience with the system serving the whole territory has justified the original contention of the promoters that the people of the district would appreciate electric lighting service if first-class, and would generally introduce it in their homes, stores, streets and public buildings.

At the place selected for the power-house, the Housatonic river made a fall of about four feet as it passed under a toll bridge carrying the highway from Canaan to Twin Lakes. This toll bridge was leased by the Berkshire Power Company during the construction period, and was of great assistance in placing the material for the dam and waste gates.

The dam itself, ninety-eight feet long, of solid concrete, resting on a ledge at the bottom of the river, extends from one bridge pier to the other, and with flashboards three feet high, creates a total hydraulic head of twelve feet. To the west of the west pier three waste gates, each eight by ten feet, are set in concrete masonry, and form the west abutment for the bridge. On the east side two concrete arches spring from the bridge pier to the rock bank of the river, and carry the roadway over the entrance chamber head-race.



POWER-HOUSE—SOUTH SIDE—SHOWING TAIL-RACE, BERKSHIRE POWER COMPANY, CANAAN, CT.

The power-house itself, immediately adjoining the entrance chamber, is a brick building on solid concrete foundations. It consists of two apartments, one containing the water-wheel shafts and gears, the other the electrical machinery. The floor of the dynamo room is carried over the head-race by two arches with a separating wall in the centre. This wall and the outside wall of the foundation are continued under the wheel room so as to form two independent wheel pits, either of which may be controlled by head-gates just outside the building. The main floor of the wheel room is of hard pine plank, removable in sections to permit access to pits and wheels. The roof throughout is of Ludovici tile on steel trusses.

The present installation is of three vertical wheels in each pit, with provision for a fourth. The wheels are set in the floor of the pit, which is formed by a concrete arch over the tail-race, and the respective tail-races for each pit are separated by a wall until emergence below the power-house.

The wheels are each thirty-nine inches in diameter, of wicket-gate type, and were installed complete with gear by the S. Morgan Smith Company, of York, Pa. The vertical shafts of the wheels are carried through yokes at the main floor-level and geared respectively to sections of a horizontal shaft, each section being connected to the next by a jaw coupling. The arrangement is such as to form a unit to which wheel capacity may be connected as the load demands.

Separated from the wheel room by a brick partition wall is the apartment for the generators and electrical apparatus. Two Woodward governors are also located in this room, each controlling one of the water-wheel units.

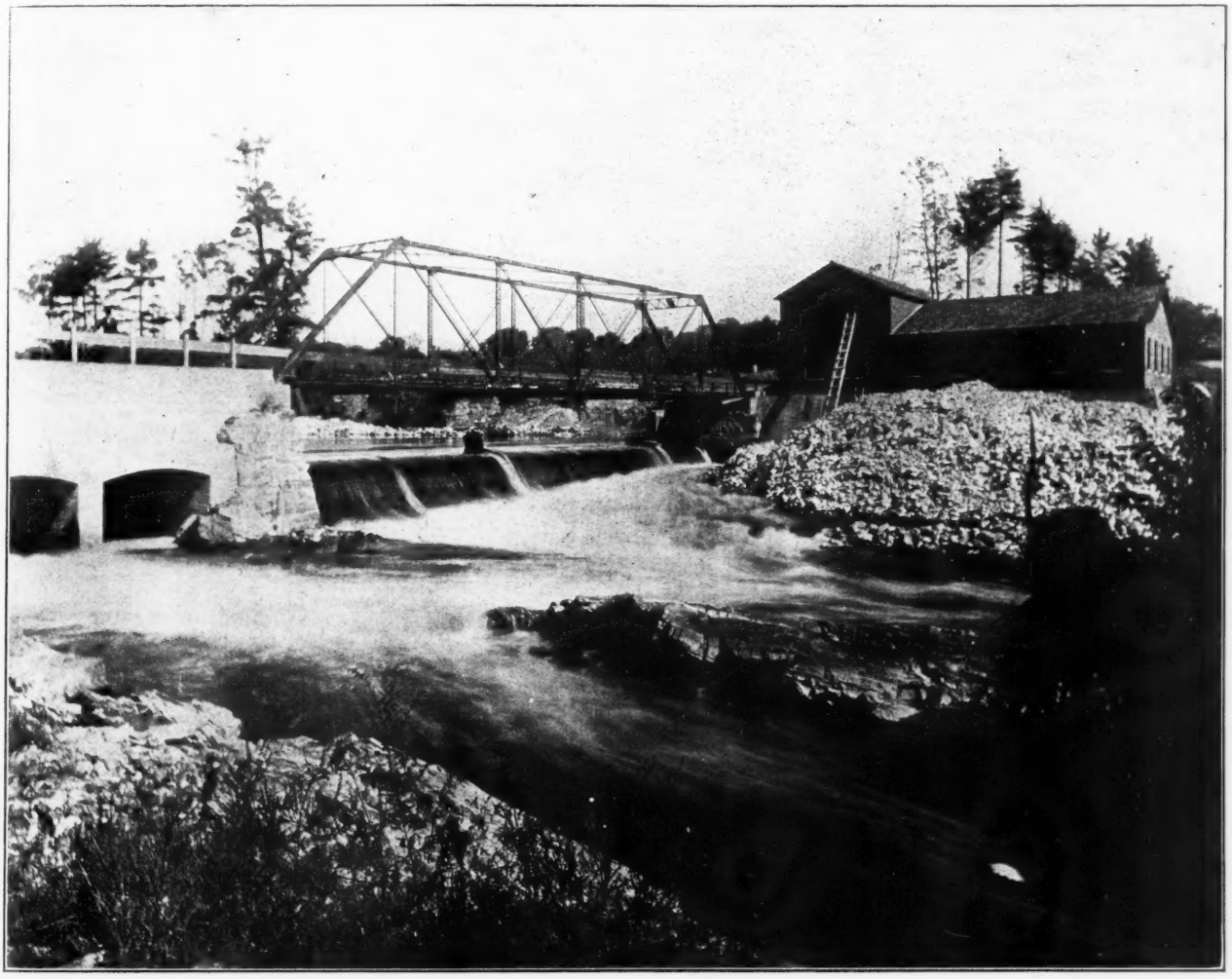
One generator of 325 kilowatts capacity is coupled to the horizontal shaft of each wheel unit, thus giving a total station capacity of 650 kilowatts. Each is of the revolving field type with individual exciting unit directly connected with it.

Lead-sheathed paper insulated cables

in fibre conduit carry the current to the switchboard and thence to the outgoing lines. All wiring is thus thoroughly concealed and protected.

The switchboard is of four panels of Tennessee marble, mounted on an iron frame in the usual manner. Two panels for the control of the generators contain each a main oil switch, field switch, direct and alternating-current ammeters, indicating wattmeter, and the necessary ammeter, voltmeter and synchronizing plugs and field rheostat handles. The other panels control respectively the main feeders to the lines of the Norfolk division on the east and the Sharon division on the west. These panels contain automatic oil circuit-breakers and integrating wattmeters. Voltmeters and a synchroscope are carried on swinging brackets at one side of the board. Current and potential transformers, and rheostats for exciters, and fields are supported in its rear.

The lines to the Norfolk and Sharon divisions leave respectively from the east and west walls of the building. Each line is protected at its point of exit by a set of three "low equivalent" lightning arresters with disconnecting switches, mounted on a bracket construction from the wall of the building. These are at such a distance from the floor as to be well out of the way of operation, at the same time easily and safely accessible for adjustment and repairs.



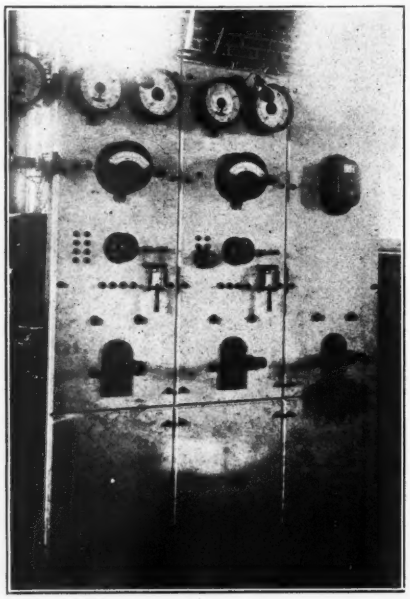
Dam, Waste Gates, and Power-House, Berkshire Power Company, Canaan, Ct.

All electrical equipment was furnished and installed by the Westinghouse Electric and Manufacturing Company.

As will be seen from this brief description, the character and arrangement of the entire equipment is of the simplest, at the same time its selection and the design of the plant involved a considerable study of the various methods of meeting the conditions involved. The fall in the river below the power-house is very slight, and in flood seasons of the year it was understood that the level of the tail-water would rise so as materially to reduce the head ordinarily to be expected. For this reason wheels, of a total capacity under the anticipated low head equivalent to the minimum capacity expected in a dry season with maximum head, were selected. The drainage area of the river and the maximum fall of twelve feet indicated that the capacity of the wheels in the dry season would be limited to about 500 horse-power on a ten-hour basis. By installing two units, each eventually to have a wheel capacity of 550 horse-power from a twelve-foot head, it was possible without a reduction of wheel speed to obtain from the operation simultaneously of all wheels on an eight-foot head the same capacity, namely, 550 horse-power. The two units installed, therefore, give a duplicate equipment during all except flood seasons, while during flood both will be required to maintain the normal capacity of the plant. Further, the separation of each unit into sub-units of wheels makes

it possible to care for the changes in the twenty-four hour load with a maximum economy of water.

Either generator is capable of developing the full normal capacity of the station, and ordinarily but one would be in operation at a time. In times of flood water, however, both machines would be required to obtain the total wheel capacity. The voltage of the generators was selected as being about the highest to which could be connected directly small individual transformers for lighting residences scattered along the line. The arrangement of exciters, governors, switchboard, lightning arresters, etc., was the result of the economical necessity of limiting the space occupied by the dynamo room, because of

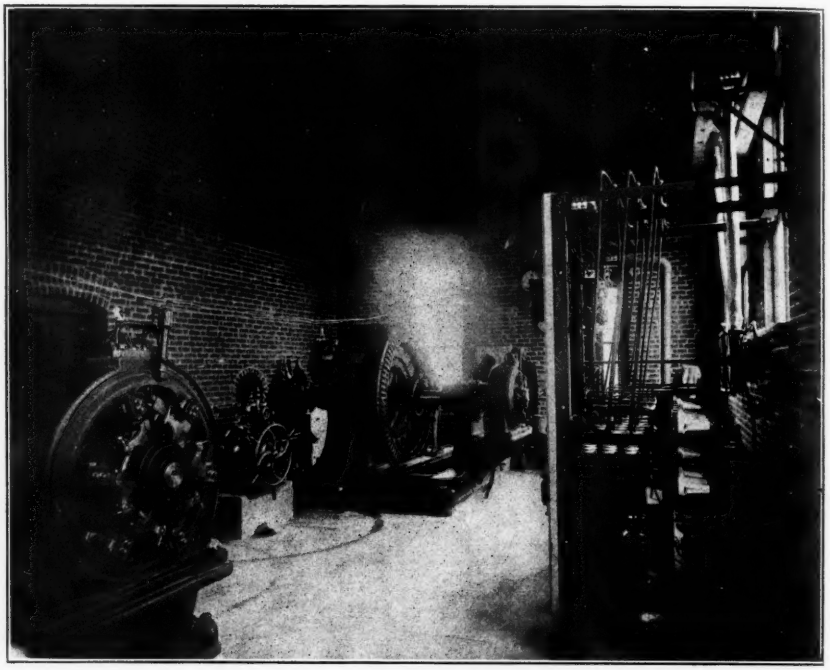


Switchboard, Power Plant of the Berkshire Power Company, Canaan, Ct.

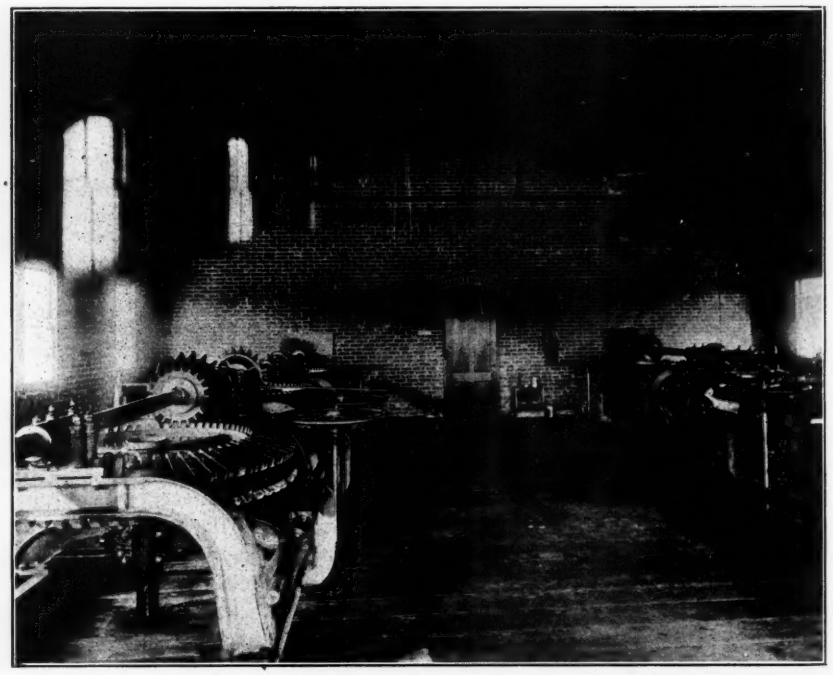
the expensive nature of its foundation construction. All this apparatus is now conveniently contained in a room twenty feet wide by thirty feet long.

An experience of a year had shown that flood water reduced the head to a greater extent than had been expected. To meet this difficulty a novel piece of apparatus was devised and has been installed during the present year, by which, on extremely low heads, the speed of the wheels may be reduced while that of the generator is maintained at normal. The apparatus is simply a geared counter-shaft around the coupling between the main horizontal shaft and the generator. The gears are arranged to slide into mesh, and in fact, the whole apparatus is on the principle of the sliding gear transmission commonly used in automobile construction. With heads above eight feet the generator is driven direct by the shaft of the wheel unit. At lower heads the drive is made through the gears. As with this arrangement the speed of the wheel is that determined, within limits, by the head available, the reduction in power is only in direct proportion to the reduction in head, and consequently the plant is fully operative at as low as a six-foot head.

Transmission lines leave the powerhouse for the Norfolk division on the east, and the Sharon division on the west. The Norfolk division includes Canaan and all the territory covered by the charter of the Norfolk Electric Light and Power Company. At Canaan transformers reduce the voltage directly to 220 volts, which is used for street and house lighting and motor installations. At Norfolk,



View in Dynamo Room of the Berkshire Power Company, Canaan, Ct.



View in the Wheel Room of the Berkshire Power Company, Canaan, Ct.

nine miles from the power-house, a substation has been established at the former power-house of the Norfolk Electric Light and Power Company on the outskirts of the village. At this point the 6,600 volts of transmission is reduced to 2,300 volts, which becomes the primary voltage of distribution throughout the village, the secondary lighting voltage being, as in Canaan, 220.

On the west the transmission line extends thirteen miles to Sharon where, because of the voltage of the existing power-house, its voltage is reduced to eleven hundred, to form the primary distribution potential of the village. The secondary voltage in Sharon is 110. The old power-house in Sharon is still maintained in operating condition and may be used on emergency to supply current to its division.

Branches from these two main lines supply intervening villages, power users and even isolated residences. The village of East Canaan is supplied in this manner, and the summer hamlet at Twin Lakes. A branch of five miles in length has just been run to Millerton, N. Y., and before the autumn of 1907 that town will be supplied with street and commercial lights from the power of the Housatonic river.

It has been a surprise to the promotors of the enterprise how rapidly the demand for electricity has grown since the inauguration of its service. As soon as its main power-house was complete the company decided to maintain current on its lines twenty-four hours each day, and this fact alone influenced a large number of new customers. A motor business at once offered itself from not only the small manufacturers and mill owners in the villages, but also from the farmers along the route. A large lime kiln decided that it could purchase power for its operations much cheaper than it could manufacture it. The result of this demand is that the power-house of the company is carrying a paying load twenty-four hours a day, and only such of the business offered as the management selects as desirable is being accepted.

The entire construction of the power plant and transmission lines was placed by the company under the charge of Walter Scott Morton, consulting hydraulic engineer, and William R. C. Corson, consulting electrical engineer, both of Hartford, Ct. These gentlemen made the complete plans for the development and installation and supervised the actual work of construction. Besides the firms already mentioned, contractors who contributed to the work were the Hartford Paving and Construction Company, of Hartford, dam and foundations; Beers & Trafford, of Millerton, power-house; and Thomas Oakes & Sons, of Hartford, transmission lines.

An Electrical Cooperator's Creed.

Some time since the Cooperative Electrical Development Association, of Cleveland, Ohio, offered a series of prizes for an "Electrical Cooperator's Creed." From among the creeds thus secured nine were selected as being entitled to share in the award. A further prize has now been offered to these nine winners for the preparation of a further creed, each having the advantage of the work of all the others. From these new contributions it is expected that one will be selected as an electrical cooperator's creed which will express the spirit of cooperation, which brought this association into being.

Herewith are two of the prize-winning creeds, one by Charles A. Parker, of Detroit, and the other by Frank B. Rae, Jr., of Newark, N. J.

BY CHARLES A. PARKER.

I believe in Electri-city—the greatest "city" on Earth.

Daughter of Science and Mother of Progress.

Sister of Civilization, Handmaid of Industry and First Cousin of the Spirit of Peace on Earth and Good Will to Man.

Lightener of Burdens, Tamer of Wilderness, Annihilator of Distance and Goddess of Light.

The most necessary of luxuries.
The most luxurious of necessities.
Who wouldn't believe in Electricity?

I believe in Cooperation.

Pennant-winning "team work," rather than individual grand-stand play.

Constructive and profitable combination as opposed to destructive and unprofitable competition.

Greater general progress through reduction of individual friction.

Working together for the Grand Prize instead of quarreling together over scanty profits.

Cooperation!—who wouldn't be a Cooperator?

I believe in Electrical Cooperation.

"All together all the time for everything electrical"—The application of the Highest Law of Modern Business to the Greatest Business of Modern Times.

The massing of forces to boost the sale of current and everything under Heaven that uses current—the Generator of an enlightened "Current Opinion."

The step-up Transformer of low-efficiency selfishness to high-voltage helpfulness—the Incandescence of enthusiasm against the resistance of Conservatism—and the Short-Circuit to the final and complete Electrification of the Universe, and to that Millennium Age when what isn't done by electricity won't be done at all.

BY FRANK B. RAE, JR.

I believe in Cooperation.

I believe that if one-half the time, labor and money now spent in commercial strife within the electrical trade were turned to account in combating the natural competitors of the trade as a whole—if but a small amount of the energy now dissipated in fighting for the business that exists were devoted to the creating of new business—it would redound to the advantage of all.

I believe that this great advantage to all can not be secured without the sacrifice upon my part of certain small advantages, the burying of certain animosities and perhaps the loss of certain immediate gains; nevertheless, I believe I am sufficiently broad-gauged and far-sighted to forego the lesser advantage for the greater.

I believe that this can be done without the submerging of my individuality or the loss of any material advantages which I will get back many fold, and of petty pride, which I can well afford to be without.

I believe the time for cooperative action is here. I am ready if you are.

The New Power Station of the South Metropolitan Electric Light and Power Company.

The South Metropolitan Electric Light and Power Company, of London, has recently erected the first instalment of a large power plant at East Greenwich, London, England. This power-house is to supply power to the company's older station, and is not to be used as a point of distribution. For this reason the electrical switching apparatus at the new station is simple. Although the area supplied is largely residential, manufacturing industries are rapidly developing there, so that provision had to be made for supplying current for power as well as light. The initial installation consists of two two-phase, 3,000-volt, 1,500-kilowatt turbo-generator units. A north wing of the building has been planned, in which will be placed two three-phase, 10,000-volt, 3,500-kilowatt turbo-generator units; and later a south wing will be constructed if necessary, the contemplated equipment for which is four three-phase, 10,000-volt, 5,500-kilowatt turbo-generator units. At the present time the company generates and transmits power to its substations as two-phase alternating current at 3,000 volts, fifty cycles, but when larger units are installed and heavier transmission becomes necessary it is purposed to raise the transmission pressure to 10,000 volts, using for this purpose the three-phase generators referred to above. Power for the two-phase system will be drawn from these generators by means of Scott transformers. Much difficulty was involved in securing a suitable foundation for this power-house, but this was done by driving many piles below the water line and placing a concrete float three feet thick over the top of these. The power-station building is one of the first instances of the use of reinforced concrete for building purposes in England. This building is 118 feet long and 116 feet wide. The auxiliaries of the plant are motor-driven, with the exception of the feed-pumps, which are driven by steam. The switch gear at present consists of only the necessary appliances for controlling two generators and supplying the output from these to the older station, which is nearby. There are three operating panels, two being generator panels and one panel for connecting the machines in parallel. The oil switches for these panels are mounted in stone compartments in the rear of the board.—*Electrical Review (London), August 2.*

ILLUMINATING ENGINEERING AND CENTRAL STATION PRACTICE.[1]

BY LEON H. SCHERCK.

What is most surprising is that the main purpose for which an electric lighting station is designed, with perhaps the exception of dividends to the owners, is, of course, to furnish the proper kind of illumination to consumers. The best engineers are generally employed to select the site, build the plant and construct the distributing system from which electric service is delivered to the premises of the customer, but right here, perhaps not a foot from the entrance of the service wires, except to see that the meters are properly located, is where most central station managers seem to think their duty stops, and the consumer, as far as proper illumination of his premises is concerned, is left to shift for himself. What is bound to be the result in a large majority of cases? Either a poorly or an extravagantly lighted place, and in consequence, a dissatisfied customer. What does Mr. A. or Mr. B. care if you have the best equipped station in the United States and the finest underground system in the world, if he is not getting satisfactory illumination? It is not sufficient to say to him, "My dear sir, the proper lighting of your place is 'up to you,'" for it is, on the contrary, strictly "up to you," Mr. Central Station Manager, and I'll try to show you why.

You will agree with me I know, Mr. Manager, that the best asset your corporation has is the good will of the public, and how can this attitude of the public toward your company be better obtained than by your encouraging, in every possible way, installations which are correctly designed; and when I say correctly designed I mean designed with a view not only to effective but to economical lighting as well. The "kick" against rates for electric lighting is most often due to the fact that the place of the "kicker" is extravagantly lighted. Rates of lighting companies are as a rule not too high, and the majority of complaints on excessive bills I believe could be readily settled if managers instead of being content to have their subordinates report in the stereotyped manner that the "meter was tested and found O. K.," would interest themselves to see if equally or perhaps more effective illumination could not be obtained at less cost to the customer. As an example, I know of a department store which a lighting company wired at a cost to themselves of several hundred dollars, the design of the installation being left to a solicitor ignorant of proper illuminating methods. After the first bill for electric lighting the merchant, at his own expense, equipped his store so as to use another illuminant entirely and ordered electric service cut off instantly. What was the trouble? "Electricity is entirely too expensive; exorbitant rates; would ruin me," and so on. About this time the lighting company employed a solicitor who had given the subject of illuminating engineering some little attention. This representative was sent to try to see what he could do with the angry merchant. An examination of the store revealed at a glance that the place was equipped with twice as many arcs as were necessary, and even with this extravagance the illumination was not effective, as the arcs were not hung at the proper height or at the right place so as to prevent shadows from pillars; the colors of the walls, too, were such that very little light was reflected. Just the exercise of a little common sense illuminating engineering changed the opinion of this merchant regarding the practicability of electric lighting, his bills were cut nearly in half, the illuminating of his store greatly improved and to-day, two years after, this merchant is one of the best satisfied customers on the company's books and is using electricity to the exclusion of other illuminants. I could, if time allowed, cite you hundreds of similar instances which have come to my attention in the past few years. This, however, is not necessary; let any of us who have allowed our "customers to shift for themselves" on illuminating matters but make an examination in our own city and town and instances will not be lacking to show the poor result of this sort of policy.

What better advertisement can you have to increase the sale of your product than a store economically and effectively illuminated, especially if this store is on a prominent thoroughfare? Isn't this place a real solicitor for you? Don't you know in the course of time, even without further effort on your part, this one properly lighted store will bring you many others, the proprietors of which in turn will adopt some of the principles there employed in securing effective illumination? Don't you really believe that had your efforts been exerted more along this line that you would have had less trouble with legislation on rates.

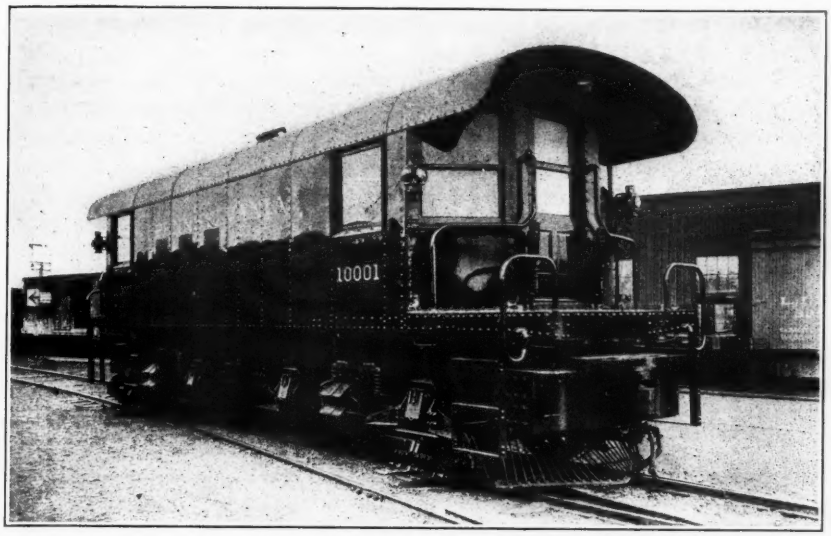
Of course to satisfy the public you must give proper service from your plant first of all; you can not sell a thing unless you have it, your lines must be correctly designed and kept up to take care of your present and of increasing business; your meters must be carefully checked, but as a rule this end of the business is carefully watched. Then in the name of common sense and for your own good, go a step further and see that practical illuminating engineering methods are applied to the benefit of your patrons. Don't put this off because you are too busy to-day with other things, as there is nothing in your business of electric lighting which is more important to the owners of your property, to the public, and from a selfish standpoint to yourself, than this matter of illuminating engineering. Don't consider any place too small to be given some little attention on this score. The large department stores with thousands to spend for illuminating, the small shop with but as many hundreds for this purpose, can both be benefited perhaps equally in proportion if you use your best efforts to see that proper methods are followed in designing the illumination of each. Don't think I am advocating that central station managers should take the place of the consulting illuminating engineer. This is farthest from my thoughts. I simply think that the central station manager should try in every way to see that patrons obtain the best possible advice on illuminating matters—in large cases by perhaps advocating the employment of competent consulting illuminating engineers, in other smaller cases by advice obtained without charge from the lighting company itself.

You may say that you are in charge of a small station, that your profits are too little for you to go into this question of illuminating engineering, and you perhaps think that it is necessary if you wish to watch the design of customers' installations that you must employ a high-priced illuminating engineer, but this is not in my opinion necessary. Of course if you have a central station in a large city I believe that a high-grade illuminating engineer is as necessary for the proper conduct of your business as is your chief electrician, but where your plant is a small one why educate yourself on this subject and in turn educate your solicitor or solicitors, even if in doing this you call in consultation at various times some good consulting engineer, many of whose services are now available. For every dollar you spend judiciously for this purpose and for every hour given in the proper study of this subject you will get handsome returns for your company.

[1] Abstract of a paper read before the Illuminating Engineering Society, Boston, Mass., July 30, 1907.

Electric Locomotives for the Pennsylvania Railroad.

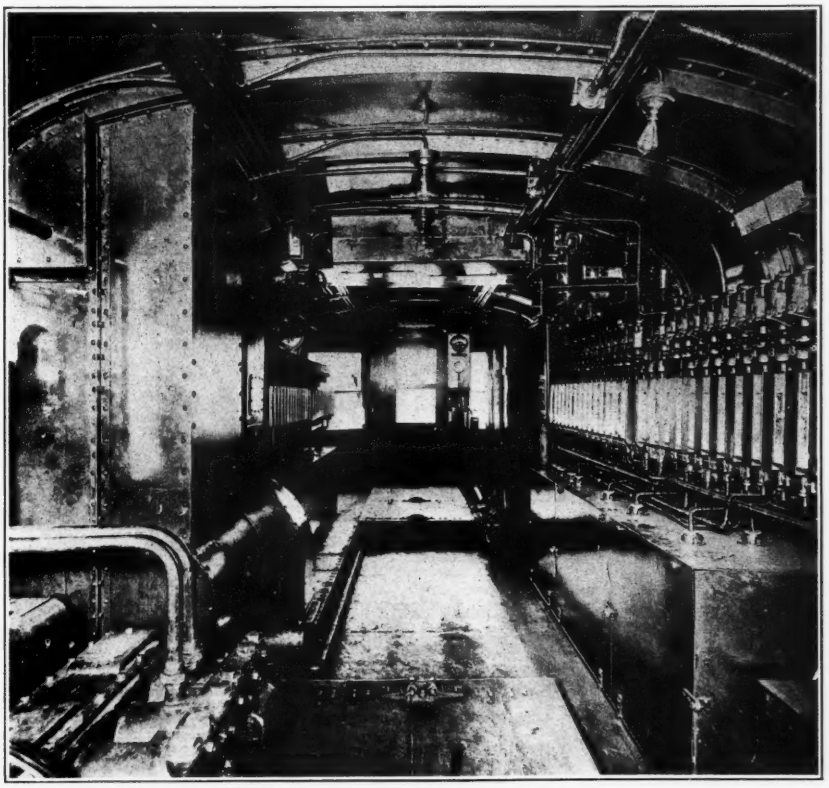
With a view of determining the type best adapted to pull its heavy passenger trains through the New York tunnels, the Pennsylvania Railroad has in progress a series of experiments upon electric locomotives.



ELECTRIC LOCOMOTIVE FOR THE PENNSYLVANIA RAILROAD.

On its West Jersey & Seashore Division and on the Long Island Railroad, two direct-current, heavy-type locomotives have been put in service. In general appearance they are quite similar and resemble a short two-truck passenger coach, with few windows and large wheels.

One of the locomotives weighs 174,100 pounds, and is equipped with four motors, aggregating 1,400 horse-power, which drive the wheels through single-reduction gears. The other locomotive weighs 195,200 pounds and is equipped with motors aggregating 1,240 horse-power, which drive the wheels directly without interposition of any gearing.



INTERIOR OF ELECTRIC LOCOMOTIVE FOR THE PENNSYLVANIA RAILROAD.

By comparing the performance of the two locomotives it will be possible to determine the relative merits of the two systems of driving. Another important question, relating to the method of supporting motors, can be settled by observing the performance of one of the locomotives. One of its trucks has motors fastened to the truck frame, and the other truck has motors which rest on springs supported by the main journals, and are independent of the truck frame.

The couplers and buffers are carried by the trucks instead of on the underframe of the car body. By this arrangement, strains of buffing and pulling are transmitted directly through the trucks and do not enter the body of the cab at all.

Overall, the locomotives measure thirty-seven feet, ten and one-half inches long, ten feet, one and three-quarters inches broad, and thirteen feet, four inches high. Driving wheels are four feet eight inches in diameter, and are supported by axles which are eight inches in diameter at the centre.

The cab is of steel, and the electrical apparatus which it contains is arranged along the sides allowing a passage through the centre. Electrical connections are so arranged that if two or more locomotives are coupled together and pulling the same train they can be controlled by the engineer of the first locomotive.

Extensive Telephone Building by the Government.

The Forest Service of the United States Department of Agriculture is putting up 2,000 miles of telephone wire on the forest reserves in the Northwest, on Lake Chelan, west of Spokane, Wash. In connection with some of this work it is necessary to lower the linemen by means of ropes and pulleys, and attach the line brackets to the rock by drilling holes into solid lava formation.

The department will expend $500,000 this year in permanent improvements in the forest reserves in the West, the bulk being on reserves in Washington, Idaho and Montana. The telephone service will keep the different watchers in touch with each other, so that concentrated efforts may be made to stifle incipient forest fires, and in this way minimize the losses which occur annually due to this cause.

THE ELECTROTECHNICAL INDUSTRY IN PERU.

BY EMIL GUARINI.

In addition to the excellent remedies recommended for special cases, but purely palliative from a general point of view (at least in the writer's opinion), there is one which will contribute powerfully to relieving the industry of Peru. This country, in place of coal, possesses a source of power in its waterfalls which the modern engineer can utilize profitably in many cases by transforming it into electricity.

The most important American and European hydroelectric stations have been constructed during the last twenty years, as it was about 1890 that active interest was shown first in the utilization of these resources, which Cavour imaginatively christened "white coal." In 1883 Fontaine, at the Vienna Exposition, demonstrated the practicability of electrical transmission of energy. In 1886 Deprez showed the possibility of utilizing advantageously water powers by means of electricity. The following years witnessed many tentative attempts, and finally, the most audacious of all, that at Niagara in 1895. The creation of this particular station had important economic consequences throughout the surrounding region, and even elsewhere. It decided engineers and investors to exploit waterfalls. Its beneficent influence has been felt in many countries. It led to the creation of new factories, and it influenced the development of new manufacturing processes and inspired important industrial discoveries.

At the present time the hydroelectric stations are still rather scarce in South America, particularly in Peru, as there are but few locations and villages which possess installations of this character. Steam-driven electric stations are also few in number.

A short time ago I called attention to this fact, after my return from a trip in the southern part of the country, at which time I submitted the first report on the condition of the electrical industries of Peru. Electric railways have been increasing since 1901. Many lines, those from Lima to Callao and in the seaside resorts in the neighborhood of the capital, are at the present time in full operation. The electric line from Lima to Chorrillos has met with such favor that the steam line connecting these places is to-day almost abandoned. It is also probable that the fares will be reduced shortly, and another company has decided to construct a second railroad following the same general course, work being begun on this during the present year.

At Lima itself the street lines still employ horses, but the street railway company has come to an arrangement with the city authorities, by means of which it will adopt electric traction over its whole system. In the next two years the city system, increased by three miles, will be converted to electricity. Santa Rose, Huacho and Chielaya are other towns which possess electric railway systems.

For supplying the light and power systems Lima possesses an installation which is probably the most remarkable in South America. This consists of two hydroelectric stations and one steam station held as a reserve. The first hydraulic station is established at the foot of the Andes and is known as the Chosica station. This utilizes a fall of 150 feet, with a flow of 1,750 cubic feet a second. The second station is at Lima, and uses a fall of eighty-one feet.

Chosica station is twenty-five miles from Lima, and uses water derived by means of a concrete conduit 650 feet above the station. This draws water from a canal ten feet deep and twenty-five feet wide, which terminates in a settling basin, where sand and gravel is deposited. The fall drives three generating groups, each of which consists of a Pelton wheel, six and a half feet in diameter, driving an alternator, which delivers current at 3,300 volts. There are also two exciter groups. This current is transmitted at 33,500 volts by means of a line consisting of two circuits of copper, arranged in triangle, on white cedar poles, the height of which is about thirty feet.

The second station is fed from a reservoir with a capacity of 190,000 cubic feet, by means of a pipe 1,800 feet long and three and one-fourth inches in diameter.

These two stations supply current to two substations, located respectively at Miraflores and La Legua, for operating the interurban railway system.

At Arequipa the electric generators, supplying a current mainly for lighting, are driven by water-wheels, which receive water from the Chile river under a head of eighty feet, by means of a canal 4,200 feet long. The mean flow of water is about 140 cubic feet a second, corresponding to a total power of 1,413 horse-power, and an effective output of 1,060 horse-power at the turbine shafts.

The station, which is operated by the Sociedad Electrica, is located at Charcana, about seven and one-half miles from Arequipa. This contains two turbine-driven alternators, each rated at 248 horse-power, consisting of a turbine using thirty cubic feet of water a second, connected to a mono-phase generator giving alternating current at 5,400 volts, sixty cycles a second. A third group, rated at 548 horse-power, produces three-phase current at the same voltage and frequency, and supplies the power system during the daytime, and at night is used for assisting the lighting generators. The total output of the station is about 1,000 horse-power, corresponding to 756 kilowatts, which are transported to the substation of Arequipa by a line 400 feet long, consisting of eight bare wires.

The fall of potential in the line is relatively large, as allowing for loss in transformation and distribution, the efficiency of which is eighty per cent, the total efficiency of the system is only sixty per cent. On the whole, these results may be considered satisfactory, and this hydroelectric station is certainly, under present conditions, one of the best in the country.

In the Tambo Valley M. Lira owns a modest electric station driven by a water-wheel, which furnishes light for the factory buildings during the working hours, supplementing in this way the steam engines.

By moving the Arequipa station about 1,200 feet, and constructing a new canal for conducting the water, it would be easy to secure from the Chile river 4,000 horse-power at least, which would be of great value for lighting the neighborhood, for operating railways, for furnishing motive power over a large territory, etc. The fall which could thus be utilized is about 300 feet instead of seventy-five feet as at present.

In another part of the Tambo Valley there is hydraulic power sufficient for lighting and supplying power which might be utilized at slight cost by means of wooden water-wheels constructed on the spot. Such a system would be advantageous for that section, since labor is unskilled and transportation facilities are few.

In the factory, as well as in the field, electricity is very valuable in every way, both from the point of view of doing work, as well as hygienically. Without great expense it could be applied for heating boilers by the induction method, thus utilizing old steam equipment.

MM. Romana and Lira have at the present time several miles of distributing

system for agricultural work and other purposes. The author is fully persuaded that in this way the effect will not be to reduce the price of labor by ten per cent. This has been the result of the work of the two gentlemen just mentioned, who by seizing a favorable opportunity for re-equipping their factory were able to extend the system considerably.

At Mollendo the supply of potable water feeding that locality constitutes, according to E. Reclus, one of the most remarkable hydraulic works on that side of the valley. This might be used as well for driving turbines. Bustamente y Barreda, an engineer, has suggested a number of modifications for utilizing this system. The canal consists of a pipe seven inches in diameter and eighty-six miles long. The fall along the pipe is 7,000 feet, and the speed of flow about two and one-half feet a second, the output being five and a half gallons a second. By installing a turbine at the lower end of this pipe, it would be possible then to obtain about 425 horse-power, giving, with an ordinary turbine, about 320 horse-power; but this plan is impossible because the pipe is incapable of resisting the pressure which would thus be brought to bear. In fact, it is cut into sections by a number of intermediate basins, so that the fall could be economically utilized with the present apparatus. The most simple solution would be to construct, at Mollendo, a second reservoir forming a storage basin with a capacity of 3,200 cubic feet. The discharge from this reservoir could be utilized for driving a turbine for the six hours of lighting. The height of fall thus created would be about 600 feet. The output being quadruple, if the water be utilized during six hours instead of twenty-four, this would make 476 horse-power available, theoretically.

A hydraulic accumulator instead of storage batteries is indispensable if the plant is to be operated under the conditions suggested. This system is advantageous, and it is to be presumed that it will be frequently adopted in Peru.

BOOK REVIEWS.

"A Text-Book of Electrochemistry." Max Le Blanc. Translated from the fourth enlarged edition by W. R. Whitney and John W. Brown. New York. The Macmillan Company. Cloth. 338 pages. 6 by 9 inches. Illustrated. Furnished by the ELECTRICAL REVIEW for $2.60.

The present book is essentially a revision and enlargement of this well-known text-book on electrochemistry. Regarding the main part of the book little need be said, as the method of treatment is familiar. The author explains the dissociation theory of electrolysis, and he presents this in an interesting and forcible manner. He makes out a strong case for his side, though the book would probably have been more satisfactory as a general text book if the other side of the question had been given fuller discussion. In the present edition a constant system of notation has been adopted which will be found of great advantage to the student. The translators have also endeavored to adopt the nomenclature in general use. In many cases new diagrams have been introduced in order to make the work more satisfactory. To those who are looking for a thorough and authoritative discussion of the dissociation theory this book is well suited.

"Electricity in Mining." Sydney F. Walker. New York. D. Van Nostrand Company. Cloth. 386 pages. 6 by 6½ inches. Illustrated. Furnished by the ELECTRICAL REVIEW for $3.50.

Mr. Walker has had a wide experience in the application of electricity to mining purposes. He here gives the results of his thirty years' work in this field. The book presents, first an elementary treatise on electricity, explains the laws of units and then takes up the application to signaling, lighting and distribution of power for all mining work. The question of generating electric power in mines is fully discussed, and the types of machines most suitable for this work described. The best methods of applying the electric motor for driving mining machinery are fully dwelt upon. The book, as a whole, covers very thoroughly all phases of electrical application to mines.

"Laboratory Work in Electrical Engineering." John Roberts. New York. D. Van Nostrand Company. Cloth. 218 pages. 6 by 9 inches. Furnished by the ELECTRICAL REVIEW for $2.

This laboratory treatise is intended as a preliminary introduction to experimental electrical engineering. Much of it is given to physical measurements, such as measurements of resistance, inductance, use of potentiometer, and measurements in magnetism. A few experiments on dynamos and motors, such as the determination of the distribution of potential about a commutator, measurements of magnetic leakage, and studies of incandescent lamps, are given. The book does not pretend to carry the student very far into the study of electrical machinery. Each experiment is described concisely, the objects to be illustrated being explained, a list of the necessary apparatus is given, the method of carrying out the work explained, and the best way to tabulate the results, and, in each case, the working out of an actual experiment helps to make the method clear.

Fault-Finding in Electric Supply Systems.

On another page of this issue is published a description of a simple and ingenious plan for indicating the burning out of a fuse on any distributing system. This has been devised by Mr. F. Schultz, and has been employed in Germany for over a year past with, it is said, very good results.

The plan is applicable only to those systems in which test wires are used with the cables. These wires were originally intended to indicate the position of a cable fault, accomplishing this by the short circuit which the fault caused between the conductor itself and the test wire. Mr. Schultz makes use of these test wires by connecting them to the feeder by means of a fine wire carried close to the fuses which are to be watched. The burning out of any one of the fuses breaks this fine wire, disconnecting the test wire from the feeder, the open circuit thus caused indicating at the central station at what point a fuse has given way. The device is applicable, it is said, to fuses of any type, and, as mentioned above, has given good results. The simplicity of the plan and the fact that it does not call for any new apparatus where test wires are available make it worthy of a trial.

Westinghouse Business in July.

The July business of the Westinghouse Electric and Manufacturing Company was considerably above the average. The last information from East Pittsburg stated that the railway department alone showed a record for orders booked approximating about $2,500,000. Among these were two of more than ordinary importance. The Brooklyn Rapid Transit Company contracted for 400 electric railway motors, 200 of which, of 200 horse-power each, are for the elevated railroad cars, while the balance, of sixty horse-power each, will be surface-car equipment. In connection with the elevated-car equipment, the company will also furnish the Westinghouse multiple-unit control. The other large order comes from the Schoepf interests of Cincinnati, which control one of the largest urban and interurban electric railway systems in this country, operating cars in eastern and central Ohio and southern Indiana. This order includes a complete equipment of electrical apparatus for twenty-four substations, consisting of rotary transformers, transformer and switchboard appliances, as well as four Westinghouse turbo-generators aggregating 26,000 horse-power.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

The Cramp Single-Phase Motor.

A discussion is given here by W. Cramp of the type of single-phase motor which he has devised. In this motor the operating current is applied to one winding on the field-frame. The current in the armature is drawn from a second winding on the same field-frame, which thus acts not only as motor field but as reducing transformer. The author contends that the characteristics of this motor are practically the same as those of a straight series motor, and here gives results of tests which he believes substantiate this claim. He shows also that with a constant terminal voltage the primary current may be expressed by a circle diagram very similar to that of the induction motor. As the speed rises the power-factor will rise, and there is no reason why the machine should not have at full load a power-factor as good as that of an induction motor. Curves are given which show that the particular motor tested gave similar characteristics whether operated according to the Cramp arrangement or as a series motor. In these cases, for a given terminal voltage the current taken by the series arrangement was a little less, while the torque given was about the same as that given by the Cramp arrangement. The particular motor tested had but two internal poles, the primary winding being placed on one limb of the core and the secondary on the other. There was a third winding intended to compensate for the armature reaction. This could be used or not, as seemed necessary. As the motor had but two poles, a high power-factor was not obtained, because it was not advisable to allow it to run at the excessive speed which would be required for this. Three arrangements of the two-pole motor design are possible—that already described, in which the armature is placed between the cores upon which the two windings are; or that in which the armature is placed at one end of the field core, the central position being taken by one of the limbs for the coils. This may be varied by placing the primary winding either on the internal or the external field limb. The first of these two is thought to be the more desirable, since then no part of the field core is required to carry both the armature and the transformer flux at the same time. For a four-pole machine the windings are most suitably placed ninety degrees apart. The author then gives an estimate of the performance of this type of motor when operating as a series motor, and according to his own arrangement. He shows that a fifty-horse-power motor designed for thirty cycles at 500 revolutions per minute on a 100-volt circuit, operating as a series motor, will require 1,100 pounds of effective iron and 600 pounds of effective copper. According to his arrangement it would require 1,700 pounds of iron and 800 pounds of copper. This excess, however, is more than compensated for by the saving of the transformer, and he estimates that in this respect the saving is equivalent to that made by an autotransformer when compared with a two-coil transformer.—*Abstracted from the Electrical Review (London), August 9.*

The Electric Driving of Cotton and Woolen Mills.

A discussion is given here by J. Nasmith of the effect on the operation of textile mills of the electric drive. He points out that during the past year there has been a wave of prosperity in the great industrial counties of Lancashire and Yorkshire, in England, and that about 8,000,000 new spindles and 77,000 new looms were installed there. At the present time steam is mainly used for driving these mills, but there are now three competitors in the field which must be recognized. The first and most important of these is the electric drive, the other two being the gas engine and the oil engine. The changes effected by the electric motor are discussed at some length, and these are illustrated by references to a number of notable installations in the counties named. Although, in actual number, the amount of such transformation has not been large, considering that the changes have been made during the last few years only, the progress has been considerable. One drawback seems to be a lack on the part of the electrical engineer to understand fully the requirements of the weaving industry. The chief advantages which textile spinners and manufacturers have to consider are summed up as follows: With the electric drive the prime mover and machinery may be placed in any relative position, and each machine may be driven independently without reference to others; and where group driving is necessary, greater simplicity is possible, with less cost in regard to shafting. The greater steadiness of driving securable by means of the electric motor brings a consequent greater output of each machine. The independence of machines gives greater immunity from breakdowns and less cost in running on light loads. If current may be obtained from a central power station there is a great reduction in capital outlay. The electric system enables a constant check to be made on the power consumption of each department. It also simplifies matters, since it makes lighting easy. Although in certain cases it may be found more economical to purchase power, with the greater number of machines it will pay to generate it at the mill itself and to drive the machinery in groups, each driven from high-speed shafts coupled direct to motors. The author then describes the transformation of a mill which had been in existence for fifty years, and up to a year ago was employing an old-fashioned beam engine. The electric system was installed, and it was found that the cost of power was only one-half cent a kilowatt-hour. Several other installations are described, which, it is said, demonstrate the adaptability of the electric drive and show that it has come to stay. For cotton mills it is thought the best system is group-driving.—*Abstracted from the Electrical Magazine (London), July.*

The Inclined Railway of Lyon-Croix-Rousse, France.

A description is given here by H. Reyval, of the electrical equipment of the Lyon-Croix-Paquet inclined railway at Lyon-Croix-Rousse, France, which has taken the place of the old steam equipment. The latter is a rather old installation, dating from 1890, and until the present year was driven by steam engines, there being two engines, either of which could be coupled to the rope drum. The incline is about 1,500 feet long and has a grade of a little over seventeen per cent. The machinery consists of a pair of drums, on each of which is wound a traction rope,

two ropes being employed in order to avoid too great a change in the direction of the pull due to the winding of the rope on the drum. The diameter of each drum is about eighteen feet, and they are driven by wooden-toothed pinions on a shaft coupled to the engine, which gear in a cast-iron wheel on the drum shaft. Each of the engines is capable of developing 250 horse-power. They are simple expansion, two-cylinder engines working non-condensing. The speed of the cable is about thirteen feet a second. Last year it was decided to substitute an electric motor for one of the engines, retaining the other in case of accident. This motor is coupled directly to the shaft of the pinion, and runs at eighty revolutions a minute, which gives a linear speed of the cable of about fifteen feet. The total dead weight consists of the train, which is made up of a passenger car and a baggage car weighing together twenty tons. A full load on the train weighs about fourteen tons, while the cable itself weighs about three and one-half, making a total of something over thirty-seven tons. This load must be lifted up the seventeen-per-cent grade, and allowing for the track resistance, it is estimated that 195 horse-power is required. To accelerate the train not only must the inertia of the train and the cable be overcome, but also that of the driving machinery and the drums. The total weight of all of this equipment is over 100 tons, and it is brought up to full speed in from thirty to forty-eight seconds, according to the load. For accelerating it is estimated that sixty horse-power is required, making the total power required to start the train 250 horse-power. Allowing an efficiency of seventy-five per cent for the method of driving, the total power required at the motor to start is about 340 horse-power. The motor installed obtains power from the railway system of Lyon at 600 volts, and is designed to take from 250 to 300 amperes. To provide against breakdowns of the distributing system, and also in order to equalize the load, an equalizing battery of 275 ampere-hours has been installed. This is sufficient to run the inclined railway until steam can be raised in the boilers of the steam plant. Advantage has been taken of this installation to return power to the batteries as the train runs down the incline. This, as well as the charging of the batteries, is controlled by a booster set. To economize energy in starting, the motor is started on a section of the battery and gradually the entire battery is cut in. To guard against accidents, automatic brakes are provided which come into action should the current fail, and also hand brakes. During 1906 the road was operated by steam at a cost of $10,200 for power. The mean number of trips was 200 a day. The electrical equipment requires three kilowatt-hours for each trip, so that for a year's operation there would be required 219,000 kilowatt-hours. The cost of this will be only $3,514. A saving of about $4,600 has thus been effected. More recently it has been found that the energy required for one train movement is only 2.8 kilowatts, which will give a still greater saving due to the electric system.—*Translated and abstracted from L'Éclairage Électrique (Paris), August 10.*

Municipal Electric Lighting.

An analysis is given here by E. S. Bradford of the present conditions of municipal electric lighting in the United States, the statistics given showing that there were, up to March of this year, 3,305 private electric lighting plants and 1,096 municipal plants. These figures do not include power companies which do not furnish light, nor mill plants lighting only a local mill or factory, nor the holding companies owning the stock of lighting corporations. These totals include both large and small concerns, and are valuable only when both the private and municipal lists contain both small and large plants in the same proportion. It is found from the figures for 1906, which differ but slightly from those of 1907, that fifteen per cent of the municipal plants and nineteen per cent of the private plants are in villages of less than 1,000 population; while seventy-seven per cent of the municipal and seventy per cent of the private plants are in places of 1,000 to 10,000 population. Over three-fourths of the lighting plants of the country, private and municipal, are in places of less than 10,000 population. The same proportion held in 1902, according to the census report of that year. There were seventy-three cities in 1906 of over 10,000 population containing municipal electric light stations. Since that year a few more large cities have voted for municipal plants, but private ownership is the stronger in the large cities, as there are more than four times as many private plants in the cities of over 10,000 population as municipal plants. The totals just given should be modified, because a single private plant frequently lights more than one city or village. This is compensated for somewhat by the fact that there are frequently two or more private plants in the same town. To grasp the full significance of the statistics of municipal plants, the amounts invested in them should be compared with those for private plants. There are no late figures available for this, but from the census report of 1902 it is found that the cost of construction and equipment of 2,620 private plants was $482,700,000, and for 815 municipal plants, $22,000,000—a ratio, roughly, of twenty to one. The gross income of the private plants was $78,700,000, which is about eleven times the income of the municipal plants, which was $6,965,000. Since 1902 there has been a vast increase in the amount invested in both types of stations, with possibly a larger per cent of increase in municipal stations than in the private. Although, numerically, the municipal plants constitute one-fourth of all the plants, the investments which they represent and their respective incomes show better the relative importance. A study of the geographical distribution of the municipal plants shows that they are much more numerous in the South and in the Mississippi valley. For convenience the states are divided into four sections, the eastern states including all states east and north from Pennsylvania and New York. In these states the percentage of municipal plants is less than twenty. The Mississippi valley group includes all states north of the Ohio from Minnesota to Ohio. In this group the number of municipal plants varies from twenty to forty per cent of the total. The same percentage is found in the southern states, which include those south from Delaware and Maryland and west to Louisiana and Arkansas. In the western group, which includes all the others, the percentage is less than twenty, with the exception of Utah, where it is twenty-three. It is thus seen that in those states where the development first started, and in the younger states, the percentage is smallest; while in the Mississippi valley and in the growing southern states the percentage is large. It is thought that this may possibly be due to the difficulty of changing from the private to the municipal system. Where the plant is a new undertaking, the municipality is more likely to take hold of it. It is said that once a plant is taken over by the municipality, it seldom goes back into private control, as only a baker's dozen have so changed from 1881 to 1902, while 170 cities transformed private management into municipal. The author calls attention to the great interest which is being shown in the question of municipal operation, and says that the running of an electric lighting plant will be less complicated than operating a gas plant, as the process is much simpler; but that it is more complicated than supplying water to a city. If the Galveston plant, or some other system should give a really efficient system of municipal operation, the number of municipal plants in the country would probably increase.—*Abstracted from the Municipal Journal and Engineer (New York), August 21.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

"Monnot" Copper-Clad Wire.

One of the most important offerings which has been made to the electrical industry is the copper-clad wire made by the method discovered by J. Ferreol Monnot, of Paris, as a substitute for hard-drawn copper wire for electrical conductors. The "Monnot" copper-clad wire is composed of a steel core coated with a welded layer of copper of any desired thickness. The "Monnot" process produces an autogenous union of the metals, and these are so perfectly welded together in the ingot or billet that the joined metals are rolled or drawn together as a a homogeneous metal. The properties of the metals are in no way impaired by the process, and the steel is improved, being protected from the action of air and furnace gases during the operations of reheating, rolling and annealing. The copper-clad wire may be used to advantage as a substitute for either steel or copper wire. Over both of these it is said to possess many marked advantages. The steel wire is a relatively poor conductor, while copper, which has a high conductivity, is deficient in tensile strength and elasticity. The combination of the two metals, however, by the "Monnot" process produces a near approach to an ideal conductor for telephone and telegraph lines.

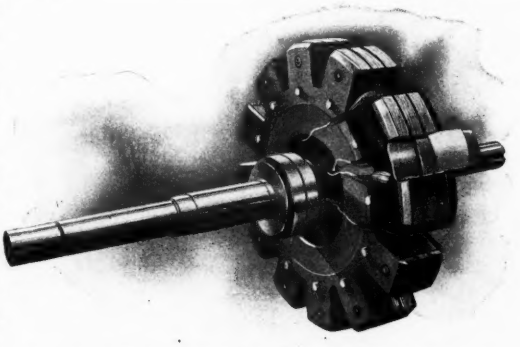
Special "Monnot" wire is produced with that conductivity best suited for its intended use by varying in its manufacture the proportion of the steel and copper to suit such requirements. Thus there is available a wire which will give different degrees of conductivity averaging from twenty-five per cent to sixty-five per cent.

The tensile strength may be varied within wide limits, according to various requirements, ranging from 55,000-60,000 pounds per square inch for low-carbon annealed wire to 200,000 pounds or even more for high-carbon spring wire.

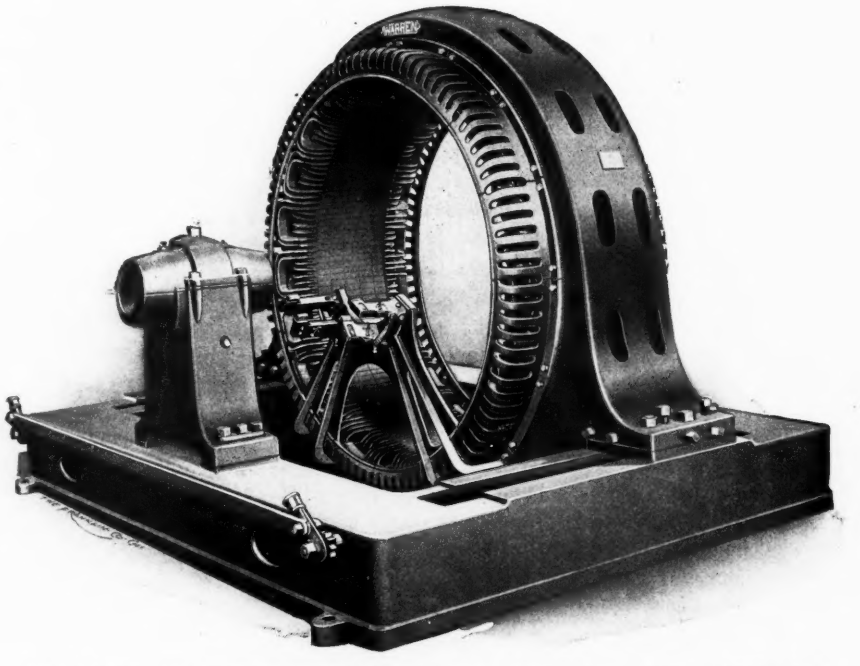
The "Monnot" copper-clad wire and other copper-clad products, such as bars, rods and sheets, are manufactured under the "Monnot" process by the Duplex Metals Company. The general offices at 208 Fifth avenue, New York city, are in charge of Avery P. Eckert, general sales manager. The works of the company are at Chester, Pa.

A New Line of Revolving-Field Alternators.

A complete line of belt-driven, water-wheel type and direct-connected engine type revolving-field alternators has been brought out by the Warren Electric Manufacturing Company, Sandusky, Ohio. These machines are made in either single, two or three-phase types, the spacing of the coil slots being such as to enable the same frame to be used for any type without changing the coils. For example, a customer purchasing a single-phase, eighty-five-kilowatt alternator can at any time convert it into a 100-kilowatt, two or three-phase alternator by merely changing the armature connections. The general construction of these machines is shown in the accompanying illustrations. The cast-iron frame is of the girder type, symmetrical in appearance, and of ample cross-section. The stationary armature is built up of stampings punched from a special soft double-annealed sheet steel, varnished on both sides before assembling. To insure the correct register of the stampings when assembling, each punch press has an index plate attachment, which automatically brings the sheet steel under the die so exactly that the individual stampings, when placed in the frame, are said to fit as though cast in place.



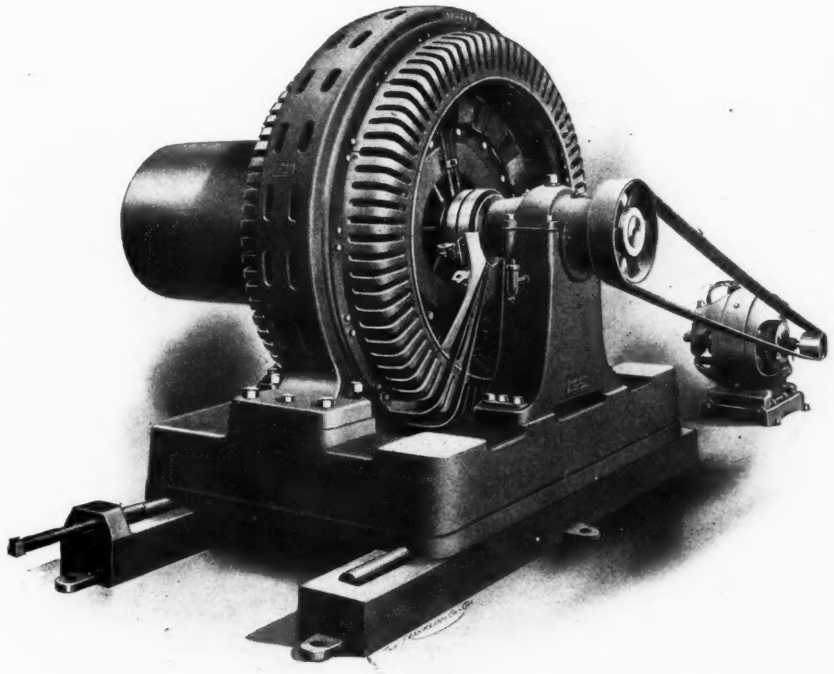
ROTOR OF BELTED-TYPE REVOLVING-FIELD WARREN ALTERNATOR.



300-KILOWATT, 257-REVOLUTIONS-PER-MINUTE, SIXTY CYCLE, THREE-PHASE, WATER-WHEEL TYPE, REVOLVING-FIELD WARREN ALTERNATOR.

The coils are wound for all voltages from 220 to 3,300. They are form-wound, of double-cotton-covered wire with a strip of insulated cloth between layers. After being wound, the coils are subjected to a high temperature, in a special baking oven,

to expel moisture, and are then dipped while hot in an insulating varnish. In this way the entire coil is thoroughly impregnated with the varnish. The coil is again baked, and thus becomes a solid mechanical structure. It is then wrapped with several layers of insulating fabric, and repeatedly dipped in varnish, the final operation being to cover it with a sheath of fibre and special oil. This is applied under pressure in heated molds, and provides a waterproof covering. For voltages above 3,300 special methods of insulation are employed. The armature coils, after being assembled in the machine, are held in place by wedges, and in this condition the windings are subjected to a breakdown test double the normal voltage.



200-KILOWATT, SIXTY-CYCLE, THREE-PHASE, REVOLVING-FIELD, BELTED-TYPE WARREN ALTERNATOR.

The field spider is of cast iron. The poles are built up of sheet-steel stampings, bolted together between steel end plates. They are designed to give a sine wave electromotive force. The field coils are form-wound, of square copper conductor with rounded edges. All field-windings are designed for 125 volts, and are subjected to a breakdown test of 1,500 volts between the coils and iron. Good ventilation is provided for the field.

Special care has been taken in the mechanical design of these alternators. The shaft is of good dimensions to secure rigidity. The collector rings are of steel mounted on the shaft by means of solid mica rings. Each ring is provided with two or more carbon brushes, so that any one brush may be removed during operation without interfering with the machine. The bearings have been designed to meet severe conditions of operation.

Up to 200 kilowatts all the belted machines have the exciter mounted on a bracket attached to the base of the machine.

These machines have been designed for operation in parallel, for which service the company guarantees them. It is stated that the efficiency is high at all loads, and good regulation is secured. The alternators are designed for continuous operation under full-load conditions without excessive heating, a liberal margin for overloads being provided. The ratings are such that the machines will carry their full rated load with a power-factor of eighty-five per cent.

Electrical Machinery in Coal and Coke Mines.

The power-house of the United States Coal and Coke Company, at Gary, West Virginia, is equipped with two twenty-four and forty-two by forty-two cross-compound heavy duty Allis-Chalmers-Corliss engines driving 750-kilowatt, 6,600-volt generators. In substations there is a total of twenty-seven seventy-five-kilowatt Allis-Chalmers transformers used for rotary converters. The general layout of this plant is similar to that of the H. C. Frick Coke Company at York Run, except that waste heat from the ovens is not used.

At the present time Allis-Chalmers Company is installing for the Woodward Iron Company, at Woodward, Ala., complete high-tension machinery for coal-mining operations. The power-house is being provided with four 400-kilowatt engine-type alternators. The current is generated at 3,300 volts, three-phase, twenty-five cycles and transmitted at this voltage to the substations, which in this instance are located underground in the mine. These substations consist of one 200-kilowatt rotary converter and three seventy-five-kilowatt transformers complete with switchboard and lightning-arrester equipment.

The Ellsworth Coal Company, at Ellsworth, Pa., which has recently been acquired by the Lackawanna Steel Company, arranged for the installation of a large alternating-current central station for distribution of power. Owing to special conditions at this plant the purchasers have installed rotary converters running as belted generators; ultimately these machines can be used as rotaries receiving alternating current from the central station. At the present time a 500-kilowatt railway-type rotary is supplying power to two of the mines on this property. At one of the more remote mines an "Reliance" Corliss engine is driving a 500-kilowatt generator.

Many other mining plants in the Pittsburg district are supplied with Allis-Chalmers machinery, among which might be noted the following:

In W. J. Rainey Company's plant at Connellsville is one 300-kilowatt "Reliance" Corliss unit and one sixty-five-kilowatt belted generator.

The Merchants Coal Company, at Boswell, Pa., recently installed two 350-kilowatt engine-type generators and 100-kilowatt booster.

The McKill Coal & Coke Company, at Glen Jean, W. Va., recently installed one 500-kilowatt alternator direct coupled to one twenty-six by forty-two heavy duty Corliss engine, also two 200-kilowatt rotary converters with transformers, exciter capacity and switchboard.

The Somerset Coal Company, at Jennerstown, Pa., has in operation two heavy duty cross-compound engines direct coupled to generators.

The Pittsburg Coal Company has on order two 500-kilowatt "Reliance" Corliss engines for installation at Grindstone, Pa. They will be direct coupled to generators.

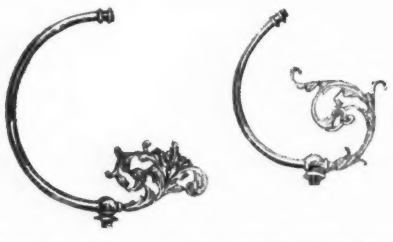
Interchangeable Electric Lighting Fixtures.

Electrical supply dealers and jobbers in many cities avoid handling electric lighting fixtures because of the large variety of styles it becomes necessary to carry in stock in order to satisfy the demand of the discriminating customer. Not alone

PATENT BODY AND STEM.

does this entail the investment of a large amount of money, but in order to make a proper display, considerable head room and shelf room must be available.

One of the most welcome innovations which has been placed at the disposal of the supply dealer and jobber is the ad-



TWO STYLES OF ADJUSTABLE FIXTURE ARMS.

justable fixture which the F. W. Wakefield Brass Company, of Vermilion, Ohio, is placing on the market. By means of the Wakefield patent body the company has designed a line of lighting fixtures so standardized that it is possible for the jobber or dealer to have a large and complete assortment of styles with very little money invested and a small stock. These standard universal lighting fixtures, as they are called, consist of a number of fixture stems and arms entirely interchangeable, from which a large variety of styles may be made up.

The stems contain the Wakefield patent body, and are made entirely independent of the fixture arms. This body allows the stem to be used for either a one-light, two-light, three-light, four-light or five-light fixture, at the will of the purchaser. The fixture arms are made so as to fit any stem, and are shipped in lots entirely independent of the stem. Any arm may be used on any stem, and by proper choosing among the various stems and arms, styles and patterns can be made to suit any demand.

FOUR-LIGHT FIXTURE ASSEMBLED WITH PATENT BODY AND ADJUSTABLE FIXTURE ARMS.

Morris Water-Wheels for the Post Falls Station of the Washington Water Power Company.

In the article descriptive of the Post Falls station of the Washington Water Power Company, appearing in the issue of the ELECTRICAL REVIEW for August 10, it was mentioned that an additional unit was being erected. This unit is being built by the I. P. Morris Company, of Philadelphia, Pa. The turbine is of the Francis type, with two bronze runners discharging into a common draft chest. It has a plate-steel casing and outside operating mechanism. The turbine is designed for a capacity of 3,260 horse-power under heads of forty-five to fifty feet, and is to run at a speed of 138 revolutions per minute.

The Uses of Copper.

The average man, if asked to name, offhand, the uses of copper, would be likely to reply that the metal was used mainly for coining pennies and making wire, yet these uses employ barely more than a quarter of the copper that is produced. On second thought, says the *Mining and Scientific Press,* he might smile at naming copper coinage as an important consumer of the metal, yet his first thought would be nearer right than his second, for the Chinese Empire has used 50,000 tons of copper for making new coins, within the past two years, thereby increasing the circulating medium of the country to the extent of four ounces for each inhabitant —for while 50,000 tons of copper is a large quantity of metal, sufficient to load 1,000 freight cars of the heaviest type used on American railroads, it is but a quarter of an avoirdupois pound per capita, when divided between 400,000,000 people.

Only the expert, or those engaged most actively in the copper industry, have the slightest idea of the diversified uses to which copper is put, as shown in "The Copper Handbook," by Horace J. Stevens. According to this book, copper enters into almost every form of human activity, and the multiplicity of its uses is most surprising. Electric light, power and traction are immense consumers of the metal in the form of wire, and telephones and telegraphs find it indispensable, yet electricity requires only a trifle more than a quarter of the metal made. The engineering trades consume more than half of all the copper produced, mainly in the form of brass, but there are about a score of friction metals and alloys, each having its specific use, into which copper enters as a component part.

The building trades are enormous consumers of copper, and this sort of consumption is increasing rapidly. Copper roofs, cornices and fronts adorn the exteriors of business buildings in thousands of towns, while for interior work the great majority of modern buildings use copper, brass or bronze locks, knobs and butts. Brass pipes, nickeled, are in modern bathrooms and lavatories, and brass and bronze chandeliers, gas and electric fixtures are almost invariable. A dozen or more other very common domestic uses of copper are mentioned.

In the manufacturing world the uses of copper and brass are innumerable. One concern in the Naugatuck valley of Connecticut buys copper in ten-ton lots, monthly, solely for the making of watch

dials, all of the better-grade dials being of copper, enameled. The common pin requires hundreds of tons of copper yearly, insignificant as a single pin may seem. Bals for shoes and tips for shoe laces require metal by the scores of tons, and the thin metallic tips on rubber-tipped lead-pencils are responsible for a surprising depletion in the stock of the metal.

In addition to the consumption of the metal itself, tens of thousands of tons of copper sulphate are required for the arts and manufactures, and for horticultural purposes, in spraying fruit trees, bushes and vines.

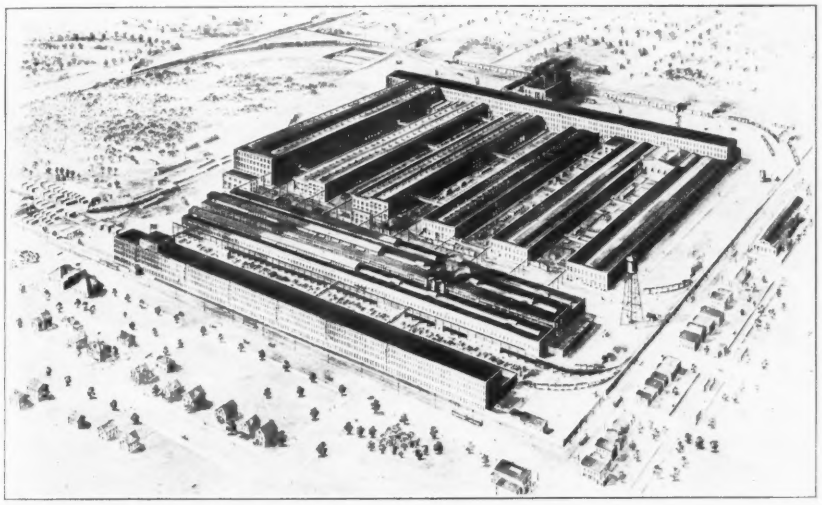
The West Allis, Milwaukee, Works of the Allis-Chalmers Company.

The accompanying illustration gives an idea of the vastness of the West Allis works of the Allis-Chalmers Company. It would appear that this industrial plant would be large enough to manufacture all of the products which might be sold by one company in the face of modern competition. As a matter of fact, the manufacturing facilities of the Allis-Chalmers Company are distributed among several large plants located in the principal industrial sections of the country. The West Allis works covers 110 acres of land. The yards about the works are covered with a network of railroad tracks supplemented by an extensive system of cranes and telphers. The industrial trackage aggregates over twelve miles in length. A power-house with a capacity of 10,000 horse-power in turbines, gas engines and reciprocating engines supplies power for operating the machine tools and provides light, heat and ventilation. Cooling and condensing water is provided in a reservoir of 5,000,000 gallons capacity. This reservoir is 260 feet long, 200 feet wide and fifteen feet deep, and the water is drawn from artesian wells.

The largest building of the group—the erecting shop—is 1,160 feet long, while the foundry and pattern shops are each 960 feet in length. The six machine-shop units are each 580 feet long.

There are 102 traveling cranes installed in the various buildings and storage yards, with a total lifting capacity of 4,030,000 pounds.

The scale of operations carried on at these works is beyond ordinary comprehension. It is a fact that single castings weighing over 100 tons are made daily for slides and bed-plates of Allis-Chalmers engines without causing the slightest disarrangement of other work which may be in hand. The melting capacity of the foundry is approximately 520 tons daily.



West Allis Works of the Allis-Chalmers Company, Milwaukee, Wis.

Jewell Precision Indicating Instruments.

The accompanying illustrations show a new type of instrument adapted to measuring both direct and alternating currents, placed on the market by the Jewell Electrical Instrument Company, Chicago, Ill. These instruments consist primarily of two coils of wire, one placed within the other. The outer coil is very light, and rotates upon fine jeweled bearings. Its rotation is opposed by two spiral springs, which serve also to lead in the current to the moving coil. The movement of the coil is rendered dead-beat by an aluminum vane moving in an annular compartment underneath the dial. This vane is of such size that, to completely damp the movement of the coil, it does not swing nearer than one-sixteenth of an inch to the walls of its compartment. Thus there is no danger of the needle or moving system sticking through the vane striking.

Fig. 1.—Jewell Standard Meter.

Fig. 1 shows the standard alternating-current and direct-current wattmeter. Fig. 2 represents the inner field construction of the instrument. By means of this new arrangement, practically all of the lines of force set up by the field coil thread through the moving coil, so that by having the axes of the two coils coincident it is possible to secure a maximum amount of torque with a minimum expenditure of energy. It is stated that by means of this arrangement it is possible to construct an instrument which has so low an amount of inductance that it may be used upon direct or alternating-current circuits of any frequency. It consumes so little energy that it may be left in circuit indefinitely without temperature variation.

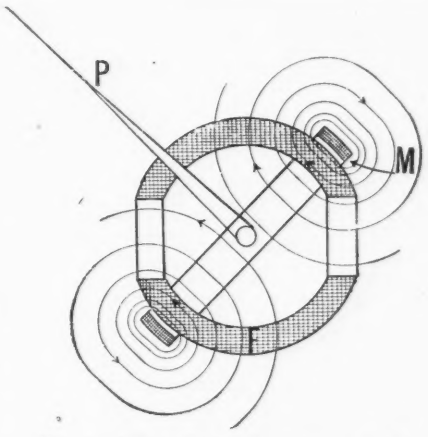


Fig. 2.—Inner Field Construction of Jewell Meter.

Gross earnings of the Mexican Light and Power Company for July (Mexican currency) were $401,204, compared with $304,836 last year. The net earnings were $237,000, compared with $164,259 in the same month last year.

Electric Dynamometers for Testing Gasolene Engines.

The Sprague Electric Company, 527 West Thirty-fourth street, New York city, has designed an electric dynamometer for absorbing and measuring the power developed by gasolene engines in factory tests. It is also suitable for testing any type of engine or motor and for measuring power from any mechanical source. The dynamometer is shown in the accompanying illustrations. Fig. 1 illustrates the apparatus in position on a supporting frame in connection with a test of a forty-horse-power, four-cylinder gasolene engine. Fig. 2 is a better view of the mounting, weight and balance levers, the coupling and frame construction.

This dynamometer differs from the well-known Prony brake in that the reaction of friction is replaced by an electromagnetic reaction. The general arrangement consists of a specially constructed direct-current generator with compensating poles. The generator field frame consists of a cylindrical magnet yoke, to the inner side of which the poles are bolted, each pole supporting a field coil. Brackets which contain the bearings are bolted to the end of the yoke, the front bracket carrying the rocker arm. Special bosses are cast on the end brackets for receiving ball bearings, which support the entire generator in such a manner as to permit the field frame to oscillate concentric with the armature.

The movement of the field frame is limited by means of a stud on the outside of the yoke, which projects through a slot in a forging secured to the side of the supporting frame. The length of the slot therefore determines the arc through which the field frame can move.

Two arms, one short and the other longer, extend horizontally from opposite sides of the field frame, to which they are rigidly secured. The short arm carries at its outer end a metal box to receive the necessary amount of lead to counterbalance the field frame on its ball bearings. The long arm is provided at its outer end with a hanger similar to that on an ordinary platform scale, on which slotted weights may be placed.

The engine to be tested is set in position and bolted to the supporting frame in alignment with the dynamometer. The two shafts are then connected together with a flexible coupling and the engine started.

The torque exerted by the armature is transmitted to the field and tends to rotate the field frame in the same direction as that in which the armature is turning. By placing weights on the hanger attached to the long arm previously mentioned, the torque is readily measured.

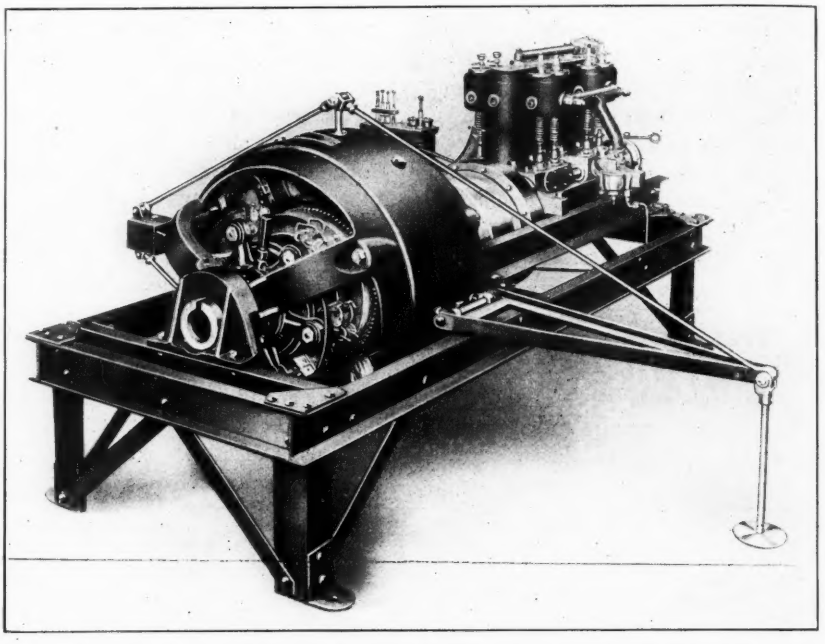


FIG. 1.—SPRAGUE ELECTRIC COMPANY'S DYNAMOMETER IN POSITION ON SUPPORTING-FRAME, SHOWING FORTY HORSE-POWER, FOUR-CYLINDER GAS ENGINE UNDER TEST.

The horse-power HP developed by the engine may then be found by using the following formula. In this formula W= the weight in pounds on the hanger, D = the distance in feet from the centre of the armature to the weight, and S = the speed of the engine in revolutions per minute.

$$HP = \frac{W \times 2\ D \times 3.1416 \times S}{33{,}000}$$

It will be noted in this formula that the only variables with a given dynamometer are the weight W and the speed S. If a curve be drawn or a tabulation made showing the horse-power developed at different speeds, an ordinary mechanic can perform the tests without making any calculations. The voltage and current produced by the dynamometer do not enter into the calculations.

In some cases it is possible to utilize the current generated by the dynamometer by connecting direct to the shop wires and operating the dynamometer in parallel with the generators already in service. Under these conditions variations in the engine speed can be obtained very easily by adjustment of the rheostat in the field circuit of the dynamometer.

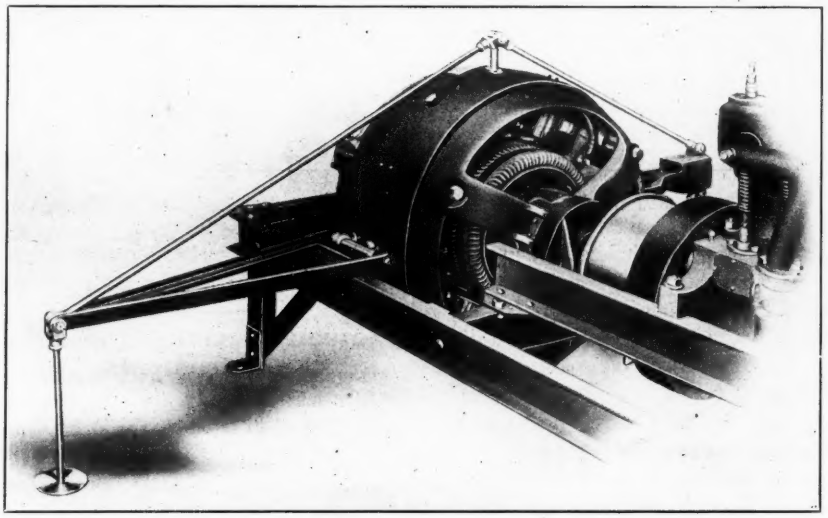


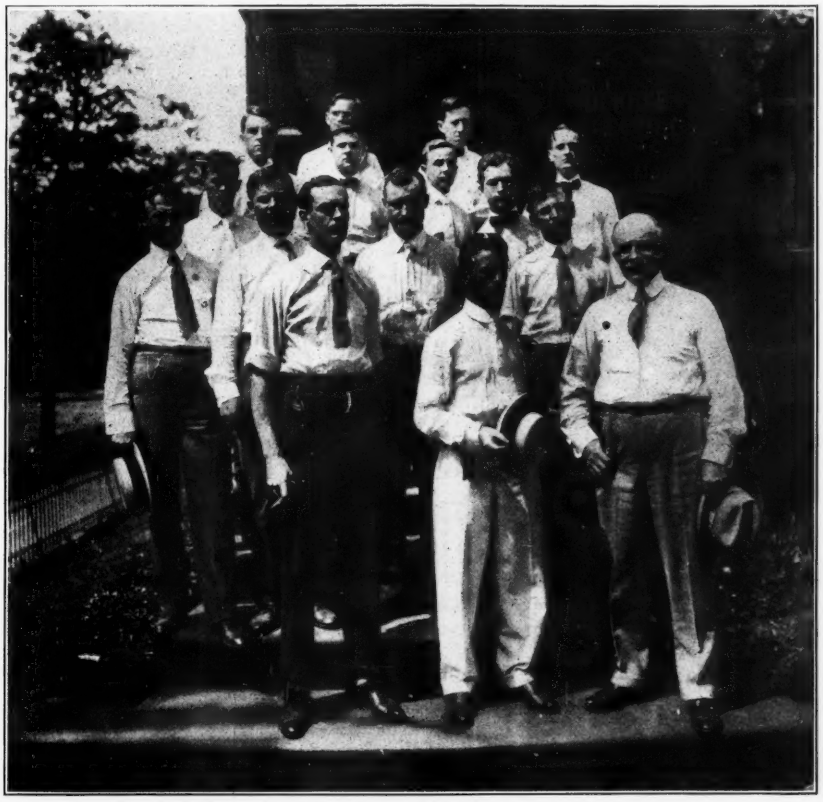
FIG. 2.—VIEW OF ELECTRIC DYNAMOMETER, SHOWING ARRANGEMENT OF MOUNTING, WEIGHT AND BALANCE LEVERS; COUPLING; FRAME CONSTRUCTION, ETC.

Electric dynamometers are manufactured by the Sprague Electric Company, in sizes from 10 to 100 horse-power, and any one of these sizes is capable of operation over a wide range of speeds and loads.

The Buckeye Company Conference.

The group photograph presented herewith was taken during the third annual sales conference of the Buckeye Electric Company, Cleveland, Ohio, August 8, 9 and 10. Those who attended the conference were L. P. Sawyer, Milton Hartman, F. W. Bliss, C. B. Gray, J. L. Mahon, Cleveland; J. H. Cooke, F. M. R. Evans, D. C. Denmark, Chicago, Ill.; W. Ennes, F. C. Foster, G. I. Barry, C. W. Cowman, Pittsburg, Pa.; J. M. Smith, West Philadelphia, Pa.; H. E. Wells, Dallas, Tex.; P. R. Slocomb, Fayetteville, N. C.

The conference included an inspection of the factory at Cleveland, discussion of factory topics and theatre party on Thursday, August 8. On Friday addresses were made by Messrs. Sawyer, Cooke, Hartman, Ennes and Bliss. On Saturday addresses were made by Messrs. Smith, Wells, Barry and Slocomb. On Saturday evening the annual dinner was held at the Euclid Hotel, at which time an informal discussion of the week's proceedings was indulged in. In every direction the outlook was reported satisfactory and the conference broke up with each man renewed in enthusiasm and eager to descend upon the central station managers with the old slogan, "Better Buy Buckeye."

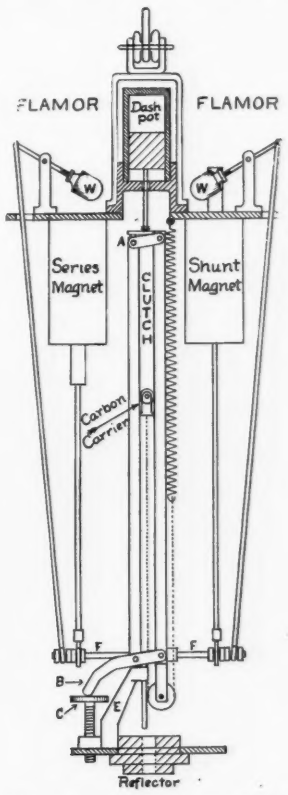


SALES ORGANIZATION, BUCKEYE ELECTRIC COMPANY, CLEVELAND, OHIO, ANNUAL CONFERENCE, CLEVELAND, AUGUST 8, 9, 10.

The "Flamor" Flame Arc Lamp.

The accompanying illustration shows a flame arc lamp designated as the "Flamor," for use on constant-potential circuits, which has been placed on the market by P. H. Klein, Jr., 33-37 Bethune street, New York city. The lamp consists essentially of a simple mechanism for maintaining a flame arc of constant voltage at the tips of a pair of downwardly pointing carbons by simultaneously raising and lowering them along converging paths. The diagram shown herewith will indicate the method of operation. When the current is shut off, the carbons abut and their tips sustain each other. When the current is turned on, the series magnet and the counterweights WW lift the clutch, which grips the carbon-carrier the moment the extended link B leaves the table C. This movement separates the carbons at their tips and strikes the arc, drawing the arc till the shunt magnet holds it at the adjusted voltage. The suspending means now slowly sinks until the carbon-carrier is released by the clutch, when the link B again bears on the table C. This, in turn, feeds the carbon. The lamp mechanism is entirely without shoes or shutters, either in feeding or for separating the carbons.

The lamp is made to operate in multiple or two in series on 100 to 125-volt circuits; or two, three or four in series on 200 to 250-volt circuits. The standard size of lamp uses fifteen-and-three-quarters-inch carbons.



MECHANISM OF THE "FLAMOR" FLAME ARC LAMP.

The Ohio Convention Exhibits of the W. J. Barr Electric Manufacturing Company.

The W. J. Barr Electric Manufacturing Company, Cleveland, Ohio, was represented at the recent convention of the Ohio Electric Light Association by W. J. Barr, president, and Lawrence W. Cady, electrical engineer. The company showed in parlor J an interesting line of electrical heating devices and exhibited for the first time the Barr ventilated stand, which will carry a heavy overload without scorching or burning.

This company was located in quarters near the convention meeting hall and the many ladies of the convention were received by Mr. and Mrs. Barr and their guests, the Misses Quayle and Lipscomb. On the morning of the last day of the gathering each lady was presented with an electric heating device. The occasion was one of much merriment, as the devices given included expensive pieces of heating apparatus, including a large coffee percolator. The gifts were greatly valued by the recipients.

Current Electrical News

DOMESTIC AND EXPORT.

OHIO ELECTRIC RAILWAY INCREASES CAPITAL—The Ohio Electric Railway Company, of Cincinnati, the Schoepf syndicate, has increased its capital stock from $100,000 to $25,000,000. This is intended to finance the merger of Ohio traction lines on which President Schoepf has been working for some years, and is another step in the consolidation of all the electric lines in Ohio identified with what is commonly known as the Schoepf system.

WIRELESS TELEGRAPH MERGER—It is announced that the American DeForest Wireless Telegraph Company has been merged into the United Wireless Telegraph Company, which is planning a monopoly of the wireless systems of the world. C. C. Wilson, of Denver, Col., has been elected president of the latter corporation. It is stated that the company, which is capitalized for $20,000,000, controls all the wireless patents in existence except the Marconi and is gradually getting control of these. Mr. Wilson is vice-president of the DeForest system. He is also president of the International Loan and Banking Company, which is the Denver fiscal agent of the United Wireless company. He takes the place of Abraham White, of New York. Since the first of the year the United Wireless company has had control of the stock of the DeForest and the minor systems. The company has completed a contract with the Japanese government and is now negotiating with Germany, Spain, Mexico and two countries in Central America for a similar service. On the Pacific coast only a few stations have so far been established.

TO BUILD LARGE POWER PLANT—For the purpose of extending its system throughout the city of Pittsburg, Pa., the Duquesne Light Company, R. C. Hall's independent concern, is arranging for the issue of $10,000,000 bonds. It is proposed to erect a mammoth power plant on the banks of the Monongahela river and to wire the entire city. The mortgage to secure the holders of the bonds has been made to the Fidelity Title and Trust Company, and has already been recorded. For the purpose of covering the expenses of immediate extensions, it is proposed to issue $1,000,000 of the bonds at once. At the present time, the management is arranging for the underwriting of an additional $4,500,000 of the bonds and the remainder will be held in reserve. The bonds are dated July 1, 1907, and are five per cent forty-year first mortgage gold bonds. One of the important projects of the company is the erection of a great power plant. This plant will be located on Second avenue. This will be operated by steam turbines and will be constructed with a capacity of 10,000 kilowatts, and so arranged that this can be increased to 50,000 kilowatts. The Duquesne company already has a plant in the East End.

RHODE ISLAND SECURITIES COMPANY DISSOLVED—A resolution dissolving the Rhode Island Securities Company, a subsidiary corporation of the New York, New Haven & Hartford Railroad Company, was passed at a meeting of the directors of the company held in the offices of the Title Guarantee and Trust Company, of Jersey City, on August 27. Secretary John G. Parker states that the action is simply a formal proceeding to facilitate the handling of the stocks of the various corporations owned by the New York, New Haven & Hartford Railroad which were held by the Rhode Island Securities Company. The resolution dissolving the company was passed by unanimous consent. By the dissolution, the affairs of the three trolley roads operating in and around Providence and Pawtucket, R. I., known as the Pawtucket Street Railway Company, the Union Railroad Company and the Rhode Island Suburban Street Railway Company, will be handled direct by the New York, New Haven & Hartford Railroad Company. The Rhode Island Securities Company was organized under the laws of New Jersey in 1902. It owned all of the $5,031,000 stock of the Rhode Island Company, formed in 1902, which leased from the United Traction and Electric Company the three trolley lines named. The New York, New Haven & Hartford acquired control of the Rhode Island Securities Company a little more than a year ago.

TELEPHONE AND TELEGRAPH.

RUTLAND, VT.—The New England Telephone and Telegraph Company has installed a new switchboard in its exchange in the Mead block.

BETHEL, ME.—The Maine Telephone and Telegraph Company will connect its system with the eight local telephone lines which centre in the Bethel office.

LINCOLN, NEB.—The University Place Telephone Company has let the contract for the construction of a $25,000 plant to the Lincoln Telephone Company. Work will be started at once.

OSHKOSH, WIS.—The Fox River Valley Telephone and Telegraph Company, which operates a system at Appleton, has purchased the plant of the Wolf River Telephone Company, which went into the hands of a receiver some years ago.

CINCINNATI, OHIO.—The Cincinnati Bell Telephone Company has placed an order for a new and improved switchboard, which will be installed to handle the local toll service. This service includes all calls outside of the city service proper, and within a radius of seventy-five miles of the city. About 200 lines are used. The improvement will enable the company to greatly facilitate the handling of this business. The new Hartwell exchange, which is being equipped with a switchboard costing $24,000, will be ready for business in November.

PETERSBURG, VA.—More than the minimum amount of stock of the Dinwiddie County Telephone Company has been subscribed and a charter of incorporation has been applied for with officers named for the first year as follows: W. M. Sterne, president; Dr. B. C. Jones, vice-president; A. J. Sutherland, secretary; L. E. Young, treasurer; board of directors: the above officers and C. M. Rives, J. C. Crawford and R. H. Lewis. The company will establish its central office at DeWitt, whence wires will be run to all points in the county. Work will be begun without delay.

CARSON CITY, NEV.—James G. Sweeney, Malcolm McDonald, J. F. Adams, H. F. Dangberg and A. B. Parkhurst, owners of the Nevada Consolidated Telephone Company, have been given a franchise to operate a telephone system in this city, and an exchange will be installed, connecting Carson with Gardnerville, Loope, Bridgeport, Markleville and Wellington. It is proposed to include Reno, Yerington and Masonic in the immediate extension of the branches to outside towns. After those wires are in operation, the entire eastern part of the state will be covered, and through connection with Salt Lake may be established.

DATES AHEAD.

Jamestown Tercentennial Exposition. Norfolk, Va., April 26 to November 30.

Canadian Electrical Exhibition. Montreal, Quebec, September 2-14.

Association of Edison Illuminating Companies. Annual meeting, Hot Springs, Va., September 10-12.

Canadian Electrical Association. Annual convention, Montreal, Quebec, September 11-13.

Old Time Telegraphers' and Historical Association and Society of the United States Military Telegraph Corps. Annual meeting, Niagara Falls, N. Y., September 16-18.

Vermont Electrical Association. St. Albans, Vt., September 18-19.

Colorado Light, Power and Railway Association. Annual convention, Denver, Col., September 18-20.

Street Railway Association of the State of New York. Annual meeting, Kingston, N. Y., September 21.

New York State Independent Telephone Association. Annual convention, Syracuse, N. Y., September 25.

Railway Signal Association. Annual meeting, Milwaukee, Wis., October 8-10.

American Electrochemical Society. Fall meeting, New York city, October 10-12.

American Street and Interurban Railway Association. Atlantic City, N. J., October 14-18.

ELECTRIC RAILWAYS.

ST. LOUIS, MO.—A franchise has been granted by the St. Louis County Court to the St. Louis, Lakewood & Grant Park Railway.

DES MOINES, IOWA—The twelve-year extension franchise ordinance of the Indiana, Columbus & Eastern Traction Company has been passed by the city council.

ALBANY, ORE.—A. Welch, of the Willamette Valley Company, has made application to the city council for a franchise to construct and operate in this city an electric street-car system.

FAYETTEVILLE, N. C.—Work has been begun on the construction of the trolley line of the Fayetteville Street Railway and Power Company. The line will take in the town of Hope Mills, seven miles south of this city.

FITZGERALD, GA.—At a regular meeting of the city council an ordinance was unanimously adopted giving a franchise for forty years to a syndicate of local and New York capitalists for an electric street railway system.

WAKEFIELD, R. I.—At the annual meeting of the Point Judith Railroad Company, chartered two years ago, the directors voted to issue additional stock not to exceed $1,000,000. This is thought to indicate that work is to be begun on the road shortly.

EMMETSBURG, IOWA—The Spirit Lake, Emmetsburg & Fort Dodge Railway Company has been formed to take steps toward building an electric interurban line from Spirit Lake to Fort Dodge. T. F. McGartna, of Pocahontas, is president.

NORWALK, OHIO—J. Y. Boyd, of Toledo, financial agent of the new interurban road from Cleveland to Indianapolis *via* Norwalk and Bluffton, Ind., has signed a contract with Western capitalists, who will supply the funds to build the road at once.

BOSTON, MASS.—The Enterprise Transportation Company has completed the building of an electric railroad from its wharves in Fall River, Mass., to connect with the main line of the Old Colony Street Railway, enabling it to carry passengers to Boston.

VALDEZ, ALASKA—The council has granted a franchise to the Alaska Home Railway, an electric line, up the Copper river. The franchise allows the use of all the streets. One hundred and fifty thousand dollars has been subscribed in Valdez alone.

WINDSOR, ONT.—It is reported that the Cataract Power Company, of Hamilton, is negotiating with the Windsor, Essex & Lake Shore electric line officials with a view of purchasing the road, thereby adding one more to its already large number of traction companies.

TRAVERSE CITY, MICH.—Voters of this city have registered their votes in favor of granting the sixty-year franchise for an electric railway, sought by the Carter Construction Company, of Chicago. The vote on the proposition was 865 for the franchise and 39 against it.

ST. CATHARINES, ONT.—The Toronto, St. Catharines & Niagara Railway has secured options for the right of way from Welland to Port Colborne. It is probable the line will be built next year. Cars will be running between Welland and St. Catharines some time during September.

YOUNGSTOWN, OHIO—Plans have been completed for an electric road from Conneaut, Pa., to Youngstown. The company erecting the line is known as the Lake Erie & Youngstown. The completion of the road will connect Conneaut with Columbia and East Liverpool, by way of Youngstown.

EAST MOLINE, ILL.—Mayor Johnson has signed the ordinance granting a franchise to the Moline & Watertown interurban. The conditions imposed by the city have been met by the company and the suits in the Federal courts dismissed. A five-cent fare over the entire route is now all that is charged.

CINCINNATI, OHIO—The increase of the capital stock of the Interurban Railway and Terminal Company from $2,500,000 to $3,500,000 is the conclusion of a plan adopted some time ago to retire the company's bonded indebtedness by substituting an additional issue of six per cent guaranteed stock.

OKLAHOMA CITY, OKLA.—Active work will be commenced at once by the Oklahoma City Rapid Transit Company on an interurban line to Norman, and it is hoped to have cars in operation by January next. The company will enter Oklahoma City over the lines of the Oklahoma City Railway Company.

PITTSBURG, PA.—The Pittsburg Railways Company has leased the old Pittsburg & Castle Shannon narrow gauge steam railroad and plans are under way to convert it into a modern interurban electric line. It is possible that by the first of the year the Charleroi cars will be running over this new route.

JEANNETTE, PA.—Engineers employed by Harrisburg and Philadelphia capitalists are locating a proposed street railway from Jeannette to Vandergrift. The engineers will report in favor of running the line from Jeannette through Claridge, Export, Bouquet, Delmont, New Alexandria and New Kensington to Vandergrift.

ELKINS, W. VA.—The Elkins Electric Railroad Company proposes to get power for running its generators from the Cheat river, and will build a twelve-mile pipe-line for that purpose, using fourteen-inch pipe. The fall between the source of supply and the power plant is so great as to give a tremendous force at the plant.

LANCASTER, KY.—The Central Kentucky Traction Company, which recently bought the property of the Bluegrass Traction Company, has filed a mortgage at Frankfort for $4,000,000 in favor of a Philadelphia trust company. The funds are to be used to build connecting lines from Lexington to other cities, including Lancaster.

BOISE, IDA.—The commissioners of Ada county have granted a franchise to the Boise & Interurban railway to extend its line over many of the streets of Boise not inside of the corporate limits. Work has already commenced on the extensions, and it is on this work that the company proposes to expend $150,000 this year.

TOLEDO, OHIO—A meeting of the protective committee of the bondholders who purchased the property of the Toledo Railway and Terminal Company at the public sale on May 28 was held at the offices of the Columbia Trust Company, New York city, on August 26, when plans were perfected for the final taking over of the property.

ALBION, N. Y.—Another company has been organized which proposes to build a trolley line from Batavia through Barre and Albion to Oak Orchard Harbor. Charles E. Hart, of Albion, is the president. The proposed road will be twenty-seven miles long. Options expiring in October have been secured on many pieces of land in this vicinity.

WASHINGTON, D. C.—It is stated that the right of way has been obtained for the proposed line of the Washington, Westminster & Gettysburg Railroad Company from Washington to the Gettysburg battlefield *via* Sandy Spring, Laytonsville and Westminster, Md., a distance of eighty miles. Surveys have been run. It is contemplated to make the road a high-speed electric line.

EAU CLAIRE, WIS.—The Chippewa Valley Railway, Light and Power Company, of Eau Claire, has filed a mortgage of $1,000,000 to the Harris Trust and Savings Bank, of Chicago, to secure bonds of the same amount. Six hundred and fifty thousand dollars is to be the amount of the first bond issue. The purpose is to use the funds for improvements, extensions and refunding the present bonded debt.

SACRAMENTO, CAL.—General Manager E. E. Calvin of the Southern Pacific says that work has already been begun on the electrifying of the lines in Alameda and that the plans for the power-house which is to be built at Fruitvale near the Estuary have been completed. It was at first intended to place this plant near the Alameda Mole, but the engineers of the Southern Pacific were unable to find a strong foundation there.

JACKSON, MICH.—It is now considered certain that an electric line between Ludington, Mich., and Grand Rapids will be completed within a year. Promoters state that eighty per cent of the right of way has been obtained and that eastern capitalists are ready to put up $285,000 as soon as farmers along the road subscribe $15,000 to show their interest in the enterprise. Several miles of road already have been graded between Ludington and Pentwater.

LEWISTON, ME.—The Lewiston, Augusta & Waterville Street Railway Company has filed a mortgage to the Old Colony Trust Company, of Boston, as trustee, to secure an issue of $5,000,000 bonds to provide for the construction of extensions and improvements to existing lines and the refunding of the outstanding bonds of the Lewiston, Brunswick & Bath Street Railway and the Augusta, Winthrop & Gardiner Railway companies, both of which have been acquired.

COLUMBUS, IND.—No money changed hands as a result of the deal here between the Columbia Street Railway and Light Company and the Central Indiana Lighting Company, by which the latter company takes charge of the local property of the former. A reorganization will be effected, stock will be issued and the local people will take stock in the new company to the value of their property. The Central Indiana company will hold the rest of the stock and will have a controlling interest.

CEDAR FALLS, IOWA—After operating a street railway at Independence for a period of nearly fourteen years, a syndicate of Independence business men has surrendered its franchise, and men are now at work removing the track and poles of the company. Since the system was built it has always been operated at a loss, and being unable to find parties that would take the franchise off its hands, the company unanimously decided to return the charter to the council and sell the equipment for what it would bring.

BROOKINGS, S. D.—The H. J. Folts Company, of Minneapolis, which has been selling the stock of the Brookings & Sioux Falls Electric Railroad, have completed their work, the required amount of stock having been disposed of. Fifty thousand dollars' worth of stock was sold, of which $15,000 worth was taken here and the rest sold to farmers along the line of road between Brookings and Flandreau, thirty miles south. It is expected that by the fifteenth of September the work of grading will have commenced.

MICHIGAN CITY, IND.—The Chicago, Lake Shore & South Bend Railway, promoted by the Hanna Syndicate, of Cleveland, Ohio, which is constructing an electric line from South Bend through this city to Chicago, will make Michigan City the general headquarters of the company. The company is building a power-house here that will cost $600,000, and has paid out $50,000 for private right of way in the city. All the grading has been finished between South Bend and this city and the track has been laid half the distance between the two points. Nearly all the grading has been done west of here.

DALLAS, TEX.—At a directors' meeting of the Dallas Interurban Electric Railway Company, which was called for the purpose, I. J. Willingham and J. Mercer Carter were unanimously elected managers of the railway company, with general powers to carry on the promotion and construction of the road under the franchise granted J. Mercer Carter, and now owned by the railway company. It is understood that these gentlemen are to devote their time, energy and ability directly to the advancement of the interest of the company, and as an initial step, will make propositions to Mesquite, Forney, Terrell and other points, including Greenville.

SHARON, PA.—Within a short time work on the construction of a new trolley line between Mercer and Greenville will begin, according to present plans of the promoters. A charter under the laws of West Virginia has been granted the Mercer Construction Company with a capitalization of $25,000. The incorporators are: T. P. Filer, L. W. Orr, and State Senator J. M. Campbell, of Mercer; Sylvester D. Downs, of Greenville, and W. Hilderbrand, of Pittsburg. It is also proposed to extend the line from Greenville to Sharpsville, connecting with the Sharon & Sharpsville. The building of the latter line will add another link to the Erie to Pittsburg trolley line, and close the widest gap.

GRAND FORKS, N. D.—J. L. Lamprecht, president of the Traction Securities Company, a company incorporated under the laws of New Jersey, and Dr. Stewart, both of Minneapolis, are at work on plans for the incorporation of the Northwestern Interurban Railway Company, with a capital of $1,000,000, for the purpose of building electric street railways in Grand Forks and Crookston, an interurban line connecting the two cities, and a continuation of the interurban line eastward from Crookston to connect with the Soo. They propose to have on their board of directors business men of Grand Forks and Crookston, in order that the interests of the two cities may be properly represented.

SALT LAKE CITY, UTAH—The Fairview Transit and Power Company is the name of an organization perfected in Salt Lake City for the purpose of building an electric railway in the town of Fairview, Nevada, to connect with all the mines of the district. It is also proposed to install an electric power plant, to furnish electric power for the mines. The company has been promoted by E. D. Lidstone, a mechanical and electrical engineer. The plant will cost approximately $50,000 and this amount will be contributed principally by Salt Lake people, although $15,000 has been subscribed by the citizens of the Fairview district. It is thought that cars will be running within ninety days.

BOSTON, MASS.—The railroad commissioners have received a petition from the directors of the Boston, Waltham & Western Electric Railroad Company asking the board to issue a certificate that public necessity and convenience require the construction of an electric railroad to connect the cities of Waltham and Marlboro and the towns of Weston, Wayland, Sudbury and Maynard. The petition is filed under the interurban act of 1906. The capital stock of the company is $240,000. The directors of the company are Atherton W. Rogers, of South Sudbury; Charles E. Stevens, of Sudbury; George A. Haynes, of South Sudbury; Winthrop H. Fairbanks, of Sudbury, and Rowland P. Harriman, of Sudbury.

STOCKTON, CAL.—San Francisco capitalists have been working upon a project to build an electric line between Stockton and the large mines of Calaveras and Tuolumne counties. The heavy land owners on Waterloo road, a highway leading to the mines, have taken up the proposition and purpose forming a syndicate to build the road. Each land owner will donate ten per cent of the acreage he holds to be either sold or subdivided into lots, the proceeds to go into the company in return for stock. The Waterloo men have enlisted the aid of merchants and farmers in all the small towns along the route of the projected road and have met with such favorable results that an engineer has been employed to survey a route for the line.

DES MOINES, IOWA—Construction work on the line of the American Electric Railway from Des Moines to Indianola and Knoxville, will be begun within sixty days. At a meeting of the directors of the road this was decided upon. The road is now practically financed. Contracts have already been let for the poles, ties and steel rails and they are expected to arrive at any time. The contract has also been let for all the steel bridges for the road. The cars will be the most modern that can be purchased. They will have all the features of a steam parlor car, including a buffet, smoking apartment, etc. The cars will be heated with hot water and electricity. C. W. Baker, general manager of the company, has returned from a week's survey of the road to Indianola. He says that cars will be running within a year. The total cost of the road will be $350,000.

ROCHESTER, N. Y.—An option on the entire stock of the Genesee & Orleans Electric Railway Company has been taken by George W. Mische and W. C. Albertson, of this city, who assert that the option will be exercised before the date of its expiration in October. The same gentlemen insist that the road will be built, not only as planned, but with various extensions to connect with other electric and steam railroads. The Genesee & Orleans Electric Railway Company was organized six years ago to operate between Batavia, Barre, Oak Orchard, Albion and Elba. The necessary certificate of necessity and convenience was obtained, but no construction was undertaken. These are the officers of the company: president, Charles E. Hart, Albion; vice-president, George W. Aldridge, Rochester; secretary and treasurer, John H. Gregory, Rochester; board of directors, Charles E. Hart, Albion; John H. Gregory, Houstan Barnard, George Wilder, Charles H. Babcock, John F. Kinney and Charles T. Chapin, Rochester, and James M. Aikenhead, Barre Center. The company is capitalized at $50,000, one-tenth of which has been issued.

NEW MANUFACTURING COMPANY.

BIRMINGHAM, ALA.—Articles of incorporation have been filed in the office of the probate judge by the Besco Supply Company. The capital stock of the company is $5,000, of which amount $1,250 is subscribed. The company will do a general electrical business and the incorporators are: H. K. Bernard, E. F. McCrossin and W. P. McCrossin.

PERSONAL MENTION.

MR. H. H. DE CEW, for several years superintendent of the Penn Yan, Keuka Park & Branchport trolley line, Penn Yan, N. Y., has resigned, owing to failing health.

MR. WALTER CARY, general manager of the Westinghouse Lamp Company, New York city, has sailed for Europe on a mission for Mr. Westinghouse. It is expected that he will be away for several months.

MR. WILLIAM W. MERRILL has resigned as president of the Appleton Electric Company, Chicago, Ill., and disposed of his entire stock holdings to Albert I. Appleton and John V. Painter. Mr. Appleton assumes the presidency of the company, of which he is also treasurer, and Mr. Painter becomes secretary.

MR. J. K. BUTLER, of Burlington, superintendent of the northern division of the New England Telephone and Telegraph Company has been transferred to Boston. The division office in Burlington will then be abolished and the territory, which includes Vermont and New Hampshire, will be divided into districts.

MR. SIDNEY E. WRIGHT, of Philadelphia, Pa., has been elected president of the Baltimore Electric and the Maryland Telephone companies, Baltimore, Md., to succeed David E. Evans, who died recently. Mr. Wright has been acting president since Mr. Evans' death, dividing his time between Baltimore and Philadelphia.

MR. JAMES P. McQUAIDE, formerly secretary of the National Conduit and Cable Company, sailed for London last Saturday, where he will have charge of the British headquarters of the Standard Vitrified Conduit Company. Mr. McQuaide possesses a wide circle of acquaintances in London, and will represent a strong and successful house.

MR. H. P. MAXIM, formerly chief engineer of the Electric Vehicle Company, who resigned on August 1 to begin the manufacture of motor cars on his own account, has been retained by the Electric Vehicle Company as consulting engineer, and will represent that organization in the mechanical branch meetings of the Licensed Association. Mr. Maxim designed nearly all the Columbia gasolene and electric cars built since the company started in business.

MR. GARNET B. HOLMES, of the firm of Holmes & Allen, of Wellington, New Zealand, is visiting the United States in the interest of the swiveling and spring-supported trolley heads of which his firm is the patentee and manufacturer. This trolley head has been widely adopted throughout Australia and in Great Britain. Mr. Holmes states that this head will save fifty dollars per car per year at least, and that it can be manufactured as cheaply as the ordinary rigid trolley head. While in New York, Mr. Holmes is making his headquarters at 116 West Seventy-ninth street.

MR. E. R. CARICHOFF, the well-known consulting electrical engineer and electric elevator expert, has closed his New York office in order to join the engineering staff of the General Electric Company at Schenectady. Mr. Carichoff will be associated with Mr. W. B. Potter in the electric railway department, and will be particularly engaged in the design of controllers. This is work in which he has had many years' experience, as he was associated with Mr. Frank J. Sprague in the development of multiple unit controllers for electric railway operation, and in the development of the Sprague electric elevator. He also acted as consulting engineer in the design and development of a number of well-known and widely used electric elevators. Mr. Carichoff is a graduate of Washington and Lee and the Johns Hopkins universities.

MR. LEROY P. SAWYER, manager of the Buckeye Electric Company, Cleveland, Ohio, will be married at an early date to Miss Jessamine A. Pike. Miss Pike is well-known in society circles, and is a vocalist and musician of considerable note. She has spent much time in study abroad and in New York, and has sung in some of the leading churches, having been the leading singer at the Unity Church, Cleveland, for several years. Mr. Sawyer is one of the younger men in the electrical field who has come rapidly to the front. He is possessed of rare personal magnetism, and is an executive of great ability. He has demonstrated unusual qualities as an organizer, and is a member of several of the governing committees of the National Electric Lamp Association. Mr. Sawyer is a graduate in electrical engineering of the University of Nebraska.

ELECTRICAL SECURITIES.

While the market was generally dull throughout the short week, the exchanges closing on Friday, because of the Labor Day holiday, favorable conditions set in quite early and on the last day considerable advances were recorded. On Friday afternoon, under the stimulus of foreign buying, the local market became more aggressive and developed a good deal of strength. It is reported that the deadlock between copper producers and consumers will soon be broken, with the situation favoring the consumers.

ELECTRICAL SECURITIES FOR THE WEEK ENDING AUGUST 31.

New York:	*Closing.*
Allis-Chalmers common	6¾
Allis-Chalmers preferred	19¾
Brooklyn Rapid Transit	46¼
Consolidated Gas	104
General Electric	127⅞
Interborough-Metropolitan common	9⅞
Interborough-Metropolitan preferred	29
Kings County Electric	112
Mackay Companies (Postal Telegraph and Cables) common	65
Mackay Companies (Postal Telegraph and Cables) preferred	62
Manhattan Elevated	118
Metropolitan Street Railway	39
New York & New Jersey Telephone	100
Western Union	75¼
Westinghouse Manufacturing Company	130

The works of the General Electric Company at Schenectady, N. Y., are in full operation. The shipments of the company last month will correspond very closely with shipments in the preceding month. The company's shipments in the first six months of its fiscal year revealed an increase of about $10,000,000, as compared with the corresponding period of last year. It is expected that the total business of the company in the current fiscal year will run close to $70,000,000, thereby establishing a new high record. Stockholders of the General Electric Company have increased twenty-four per cent in number since January 1, 1907. At the opening of the year the company had about 5,400 stockholders. On August 1 this number had grown to 6,700, a gain of 1,300 in seven months, or at the rate of about 200 per month.

Boston:	*Closing.*
American Telephone and Telegraph	105½
Edison Electric Illuminating	206
Massachusetts Electric	50
New England Telephone	108
Western Telephone and Telegraph preferred	—

Philadelphia:	*Closing.*
Electric Company of America	9
Electric Storage Battery common	44
Electric Storage Battery preferred	44
Philadelphia Electric	7⅞
Philadelphia Rapid Transit	15¾
United Gas Improvement	87

The earnings of the Philadelphia Rapid Transit Company for the fiscal year have been very favorable. In July the gross increase was $180,000 over 1906, and it is believed that the August increase will be more than $100,000.

Chicago:	*Closing.*
Chicago Telephone	107
Chicago Edison Light	137
Metropolitan Elevated preferred	63
National Carbon common	72
National Carbon preferred	112

OBITUARY NOTE.

MR. EDWARD R. COFFIN, vice-president of the Electric Securities Corporation and an officer and director of many electrical companies, died on September 2, in the General Hospital at Omaha, Neb. Mr. Coffin was stricken a week ago on a train while on his way from San Francisco to New York city. He was a son of Charles A. Coffin, president of the General Electric Company, and made his home with the latter at 145 West Fifty-eighth street. Mr. Coffin was graduated from Harvard with the class of '93 and engaged in the electrical business. At the time of his death he was vice-president of the Asheville Electric Company, the Chattanooga Electric Company and the Des Moines Electric Light Company. He was a director of the Animas Power and Water Company, the Central Colorado Power Company, the Duluth Edison Electric Company, the Grand Rapids Edison Company, the Omaha Electric Light and Power Company and the Le Grange Mining Company. He was a member of the Knollwood, University, Calumet and Metropolitan clubs.

ELECTRIC LIGHTING.

MOSELLE, MISS.—A company has been organized for the purpose of installing a lighting plant for the town.

CHARLOTTE, N. C.—The Southern Power Company has placed in operation its Great Falls plant.

EVANSVILLE, IND.—A. L. Swanson, of this city, has been awarded the contract for an electric light plant at Shawneetown.

GOLDSBORO, N. C.—The engine and boiler for the city electric plant have arrived, and will be installed in the new plant on Little river.

IRONDEQUOIT, N. Y.—The town board has granted the Rochester Railway and Light Company a franchise to supply heat and light to the town.

NEW ALBANY, IND.—Georgetown, eight miles west of New Albany, is contemplating the installation of an electric light plant and waterworks system.

BIG SPRINGS, TEX.—The Big Springs Electric Light Company's plant, which was burned about a month ago, is again in operation, having installed a new dynamo.

TURLOCK, CAL.—The Turlock Electric and Water Company will install an electric light and water plant. A franchise for lighting the town has been granted the company.

WICHITA, KAN.—The Wichita Gas, Electric Light and Power Company has ceased to do business having transferred its property to its successor, the Edison Light and Power Company.

FARGO, N. D.—Manager R. W. Clark has completed his plans for enlarging the power plant of the Union Light, Heat and Power Company. The company will expend about $30,000 in improvements.

GOLIAD, TEX.—The commissioners' court has granted Dr. L. W. Chilton the privilege of erecting poles, etc., for an electric light plant in the city of Goliad, and work on the plant will begin shortly.

BLACKSBURG, S. C.—The Southern Power Company has suspended work at Ninety-Nine Islands, on Broad river. It is said that the suspension is only temporary, probably for about sixty days. No reason is given for the shutdown.

COUNCIL BLUFFS, IOWA—The sale of the Carroll heat, light and power plant, which has been in hands of a receiver for several months, has been consummated. George H. Long, representing the Michigan bondholders, bid in the plant at $71,000.

JACKSON, KY.—N. B. Combs has secured a franchise from the board of trustees to operate an electric light plant in this city, and has purchased at public sale the plant and property of the Jackson Electric Light and Power Company. He will install new machinery.

WATERBURY, CT.—The Connecticut Railway and Light Company has announced a reduction of from ten to thirty per cent in the price of electric current, affecting in addition to Waterbury, the following towns: Naugatuck, Watertown, Oakville, Waterville and Cheshire.

MT. PLEASANT, TEX.—Plans are being perfected for building an electric light plant at Winnfield, eight miles west of here on the Cotton Belt. The capital stock is being subscribed by the business men of the town, and it is hoped to have the plant in operation within six months.

SEWARD, NEB.—The annual report of the Seward electric light plant shows that last year the plant expenses were $8,071.41. The income was $11,213.38; $5,632.32 was invested in a new boiler room and the installation of the boiler. The city waterworks cost $1,763.79 and earned $2,106.05.

BIRMINGHAM, ALA.—The Tidewater Electric Company, which has secured valuable franchises in Gadsden, Birmingham and Tuscaloosa, has filed notice of an increase in capital from $100,000 to $150,000, but no statement has been made with regard to when construction is to commence.

ALBANY, N. Y.—The Rockland Light and Power Company, of Nyack, Rockland county, has been authorized by the public service commission of the second district, to issue a general mortgage of five per cent, thirty-year gold bonds to the amount of $500,000, out of a total authorized issue of $1,000,000.

ELDORADO, OKLA.—Captain W. B. Bryant and W. B. Kennedy, of Mangum, members of a company that proposes to install an electric light system, will proceed at once with the work. The company has been granted a franchise by the city council and 500 service contracts have been signed by citizens of the town.

DECATUR, ALA.—Manager H. B. Johnson, of the Decatur Light, Power and Fuel Company, states that his company expects to spend the sum of $30,000 on the improvement of their plant in New Decatur, which supplies both Decatur and New Decatur with light and power. This plant also furnishes power for the North Alabama Traction Company, of the Decaturs.

HERKIMER, N. Y.—The municipal commission which has charge of Herkimer's municipal electric lighting plant will increase the incandescent lighting facilities by the installation of a 325-horse-power engine and a 200-kilowatt generator. The engine was ordered of the American Ball Engine Company, of Bound Brook, N. J., and the generator of the Crocker-Wheeler Company, of Ampere, N. J.

MILWAUKEE, WIS.—Allard J. Smith and E. B. Pares, of Milwaukee, are promoting a new electric light and power company which is to take over the old Lurvey mill, a mile and a half south of Dousman, Wis., and remodel it into a power plant. It is proposed to provide power in Dousman, the new Masonic home, the summer cottages at Golden Lake, and at Sullivan, Wis., besides points en route.

CRIPPLE CREEK, COL.—The city council has effected a saving of $13,396 by the ratification of a lighting contract with the Gold Belt Electric Company. The new contract covers three years from last February at the rate of $10 per arc light. The former rate was $13.50. The bill for the past six months for lighting the city, $6,160, which had been held up pending an agreement, was allowed and ordered paid.

TULSA, I. T.—The Tulsa Electric Company, an organization composed of Tulsa business men, has been formed for the purpose of furnishing electric light and power to the residents of Tulsa. The new company is incorporated for $15,000 and will immediately begin the erection of a power plant to cost in the neighborhood of $30,000. C. A. Brown, D. M. Martindale, Ben Rice, R. D. Campbell and J. C. Noble are among its members.

MACON, GA.—The new electric company, chartered as the Americus Railway and Light Company, has taken over, by purchase, the electric and gas plant here. The new company is capitalized at $250,000, and will begin immediately the construction of an entirely new plant. The new company is also under contract with the city to construct and operate, for the term of twenty years, an electric street railway of five miles minimum circuit.

ALBANY, N. Y.—The up-state public service commission has denied the application of the Newburgh Light, Heat and Power Company for leave to increase its capital stock from $500,000 to $750,000, and to classify the capital stock so increased into $500,000 of common stock and $250,000 of eight per cent cumulative preferred stock. The application really was for permission to issue the $250,000 eight per cent cumulative preferred stock.

TROY, N. Y.—The Schaghticoke Electric Company, of Hoosick Falls, has made application to the public service commission of the second district to increase its capital from $30,000 to $500,000 and also for consent to issue $1,750,000 of five per cent twenty-five-year first mortgage bonds. The company has been making preparations to develop power on the Hoosick river and intends to erect a high-tension transmission line from Schaghticoke to Schenectady.

PITTSBURG, PA.—A substitute ordinance, asking a fifty-year franchise instead of a twenty-five-year grant, will be presented to Pittsburg councils by the Diamond Light and Power Company. The company is at present a private enterprise that supplies electric light to a few stores in the vicinity of the Diamond market. The men forming it want to enlarge their business and become a public service corporation. In their ordinance they have a clause agreeing to furnish arc lights to the city at not more than $70 a

year. The city now pays the Philadelphia Company $76, and the ordinance of the Southside Electric Company provides for lights at not over $75.

ANNISTON, ALA.—The work of securing the right of way for bringing the power from Jackson's Shoals, near Talladega, to Anniston, will be started at once, and already materials have been ordered for building the necessary lines. It is understood that these steps are being taken by the Electric Share and Bond Company, which owns the Jackson's Shoals power rights in addition to owning the Anniston Electric and Gas Company and other electric light and power franchises.

PITTSBURG, PA.—The Southside Electric Manufacturing Company, a West Virginia corporation, will apply to Governor Stuart, on September 9 for a charter in this state. The stockholders plan to increase the capital and enlarge the plant for the purpose of furnishing light and heat to residents and stores and factories on the south side. The capitalization is now $65,000. The officers of the company are: L. J. Regan, president, and Peter M. Lippert, secretary and treasurer. The other members mentioned in the application are C. W. Cauffeld, Louis Kimmel and R. E. Kearns.

MORRISTOWN, N. J.—The board of directors of the Morris & Somerset Electric Company, at a meeting instructed its executive committee to immediately let contracts for the construction of the company's electric lighting plant and to hasten its completion. The committee is composed of Samuel S. Childs, Samuel B. Carson and Peter V. Stryker. The latter is the general manager of the company. It is said that the plant will cost about $200,000. Fully one-half of the stock of the company has been subscribed for. It is held by residents of Morristown, business men and others, who are large consumers of electricity.

DUNSMUIR, CAL.—The Southern Pacific company recently laid claim to the use of 5,000 inches of the waters of the Sacramento river in the cañon above Dunsmuir. Nothing was given out at the time regarding the use to which the water was to be put, but it is now learned that the purpose of the company is to use the water for developing power in an electrical plant. A plant of considerable magnitude will be built at once, the primary object being to supply the necessary energy to operate the electrical block-signal system between Redding and Ashland. Sufficient electricity will be generated to supply the railroad shops at this point with power and light, and it is thought that electric motors may also be utilized to assist in moving freight trains over the division in the not-distant future.

BALTIMORE, MD.—The Susquehanna Pole Line Company has been incorporated in Harford county by H. Clay Whiteford, J. Alexis Shriver, Alexander S. Bell, O. M. Whitaker and Joseph T. Deckman, of Harford, with a capital stock of $50,000. This company, in connection with the Pole Line Company, of Baltimore county, which was recently formed, will build a pole line from McCall's Ferry, Pa., to Baltimore for the transmission of electric current from the plant on the Susquehanna river. The incorporators of the Baltimore county company are: George R. Willis, Alexander McCormick, Thomas B. Gatch, Charles W. Kennard and John T. Murphy. The company had not completed its plans, but the route to be used is under consideration. It is planned to build a boulevard along the route, and to erect steel towers. McCall's Ferry is about forty miles from the city.

SPOKANE, WASH.—Announcement has been made that the Washington Water Power Company will shortly invade the Big Bend country and will construct a power line which will supply light and power to all the cities and towns of the district. Power will also be furnished the mills of the Big Bend country. The company is composed of Spokane and outside men. W. C. Sivyer is at the head of the new enterprise and will practically manage the company. Associated with him are D. B. Fotheringham, H. L. Bleecker and Thomas K. Binnie, of Spokane, and Eugene Enloe, of Medical Lake. The company has closed a contract for light and power with the Big Bend Milling Company, of Davenport, and contracts have been signed for power for Ritzville, Reardon, Harrington, Sprague and Paha. According to the statement of D. L. Huntington, of the water power company, his company will construct the line and will sell at wholesale power to the Big Bend company. That company will secure the contracts and furnish power to those desiring it. Work on the new line will be commenced immediately. The new company has contracted to furnish power to the Big Bend Milling Company commencing January 1, 1908.

NEW INCORPORATIONS.

NEW ORLEANS, LA.—Union Electric Company, Hattiesburg, Perry county. $5,000. Incorporators: A. N. Sexton, C. S. Sutherland.

LOS ANGELES, CAL.—Santa Maria Electric and Gas Company. $250,000. Directors: T. A. Crowe, G. E. Reid, A. C. Hunt, M. Dawson, W. L. Percey.

MEMPHIS, TENN—The Economy Electric Company. $5,000. Incorporators: J. B. Hutchinson, E. R. Pelham, J. A. Rose, J. H. Lucas and Clarence C. Nelson.

NEW YORK, N. Y.—Niagara Falls Lighting Company, Niagara Falls. $100,000. Incorporators: A. McCausland, J. E. Rock, J. W. Searing, New York; W. J. Bagnall, Brooklyn.

MILWAUKEE, WIS.—The Baldwin Electric Light and Fuel Company, Baldwin, St. Croix county. $15,000. Incorporators: E. J. Cave, O. K. Hawley, Herman Heebink and seven others.

SHAWNEE, OKLA.—The Electric Security Company. Organized for the purpose of holding securities in various electric plants owned by C. R. Dean, of Shawnee, and two Chicago associates, in various parts of the territory. $3,000.

BATH, ME.—Penobscot Bay Electric Company. To make, generate, distribute, supply and sell electricity for heat, power and light in the towns of Buckport, Orland, Penobscot, Castine, Bluehill, Winterport, Frankfort, Stockton Springs and Verona. $200,000. President, William M. Shaw, of Greenville; treasurer, Albert H. Shaw.

INDUSTRIAL ITEMS.

C. S. GARRETT & SON COMPANY, 20 South Marshall street, Philadelphia, Pa., will be pleased to send literature concerning whalebone insulation and rawhide fibre for electrical purposes. This company is the manufacturer of various forms of insulating papers and fibres, samples of which may be obtained upon request.

THE SPRAGUE ELECTRIC COMPANY, New York city, is sending out an attractive advertising card, printed in two colors calling attention to its well-known Greenfield flexible steel conduit. The card shows an excellent illustration of the Pennsylvania State Building, at the Jamestown Exposition, which was wired with the Sprague company's conduit. This building is a reproduction of Independence Hall, Philadelphia.

H. H. LYCHE & COMPANY, 908 Security Building, Chicago, Ill., is the manufacturer of the Ackerman programme clock for schools, hotels and large institutions. This apparatus is arranged with a system of jacks and plugs, so that in combination with a clock it will carry out any predetermined set of functions. The clock is electric and self-winding, and is said to need no attention after the programme has once been arranged.

THE PHELPS COMPANY, Detroit, Mich., it is announced, has made a general assignment for the benefit of its creditors. The Union Trust Company has been named as assignee. The officers of this company are: William E. Phelps, president; W. J. Phelps, vice-president; James V. Oxtoby, secretary, and J. H. Hilton, treasurer. The company has manufactured the "Hylo" turn down incandescent lamp and other electric lighting specialties, and is well-known throughout the electrical industry.

THE AMERICAN INSTRUMENT COMPANY, 1114 Chestnut street, Philadelphia, Pa., has ready for distribution, catalogue No. 65, devoted to electrical measuring instruments. This is a particularly handsome and complete listing of switchboard instruments, portable instruments and shunts. The illustrations are very clearly printed, and the descriptive matter goes into considerable detail. Carefully prepared diagrams showing dimensions are given, and full information concerning weights and prices is included.

THE DOUBLEDAY-HILL ELECTRIC COMPANY, Pittsburg, Pa., announces the opening of a Charlotte (N. C.) branch warehouse, which will take care of the requisitions for southern trade. A large and comprehensive stock has been placed in this warehouse, covering the best lines of material, such as "O. K." weatherproof

wire; "Parac" rubber-covered wire; Bryant, Perkins and Paiste materials; Emerson alternating-current desk and ceiling fans; Peerless lamps; Hubbell specialties, etc. From this stock the demand of the lighting stations, contractors, street railway companies and telephone systems can be promptly supplied.

THE GREEN FUEL ECONOMIZER COMPANY, Matteawan, N. Y., in bulletin No. 113 describes the Green fuel economizers at the Manhattan power station of the Interborough Rapid Transit Company, New York city. This is a reprint of a paper read by R. D. Tomlinson before the New York Railway Club. The paper showed by a careful analysis of tests and monthly records that the economizers in this plant are paying a net rate of 30.5 per cent upon the initial outlay. This is based upon a price of $3 a ton for coal, and the average load at the time the economizers were put in. The plant contains sixty-four boilers of 520 boiler-horsepower each, and the draft is produced by four brick chimneys. The pamphlet is illustrated, and may be obtained by addressing the company.

Record of Electrical Patents.

Week of August 27.

864,154. DEVICE FOR ALARM AND DETECTING BURGLARY. Paul Brauer, Wittenberge, Germany. An alarm with a photographic attachment.

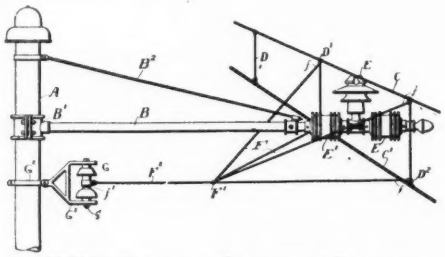
864,167. INSULATING CONDUIT FOR ELECTRIC WIRES. Anthony P. Hinsky, Hoboken, N. J. A tubular conduit, smooth internally, corrugated externally.

864,228. TROLLEY HARP. Frank H. Brueggeman, Norwood, Ohio, assignor, by mesne assignments, of one-half to the Acme Automatic Street Indicating Company, Cleveland, Ohio. The harp is provided with oil reservoirs.

864,251. CATENARY SUSPENSION BRACKET FOR CURVES. Elmer P. Morris, East Orange, N. J. A braced bracket.

864,252. CATENARY SUSPENSION BRACKET. Elmer P. Morris, East Orange, N. J. Secondary insulators on the bracket prevent grounding.

864,261. ELECTRICAL CUTOUT SWITCH. William H. Ringwood, East Pittsburg, Pa. A detachable cam switch for poles.



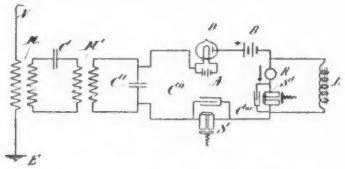
864,252.—CATENARY SUSPENSION BRACKET.

864,272. SPACE TELEGRAPHY. John S. Stone, Boston, Mass., assignor to William W. Swan, trustee, Brookline, Mass. A receiving system for wireless telegraphy.

864,297. STORAGE BATTERY. William Gardiner, Chicago, Ill., assignor to Cornelius P. Stringfield, Chicago, Ill. Trough-like juxtaposed sections provided with openings at one side are used.

864,306. ELECTRIC SWITCH-OPERATING DEVICE. Frank A. Johnson and David A. Robbins, Danville, Ill. The track switch-operating mechanism controlled by the trolley pole.

864,332. TELEPHONE ATTACHMENT. Albert S. Perry, Yukon, Okla. An auxiliary switch on the instrument.



864,272.—SPACE TELEGRAPHY.

864,341. ANNUNCIATOR. Fredric Sidler, West Pullman, Ill. A ratchet attachment for electric annunciators.

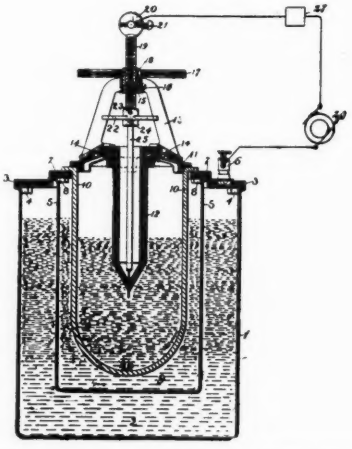
864,344. FLUID-PRESSURE SYSTEM. Samuel B. Stewart, Jr., Schenectady, N. Y., assignor to General Electric Company. An automatic electric control for fluid pressure systems.

864,348. ELECTRIC-WELDING CLAMP. William E. Williams, Chicago, Ill. A clamp for holding the work close to the weld.

864,382. SUPPORT FOR TELEPHONE RECEIVERS. John S. Mills, New Granada, Pa. An adjustable support for telephone receivers.

864,454. TESTING SYSTEM FOR TELEPHONE LINES. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. A test relay common to the cord circuits is used.

864,519. APPARATUS FOR THE ELECTRIC OPERATION OF TYPE-SETTING MACHINES. Heinrich Drewell, Hanover, Germany. The apparatus is operated by electromagnets.

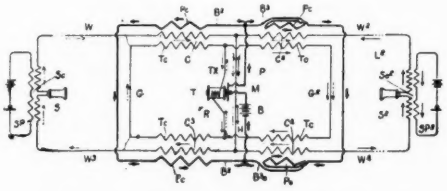


864,695.—RECTIFYING AND INTERRUPTING ALTERNATING CURRENTS.

864,520. TROLLEY-WIRE HANGER OR EAR. Harry G. Dyer, Gloucester City, N. J., assignor of one-half to William J. Van Meter, Gloucester City, N. J. The ear presents a smooth under surface after the wire is clamped.

864,535. ELECTRIC-LAMP ADJUSTER. Wilson S. Hawker, Dayton, Ohio. An adjustable incandescent lamp support.

864,542. BRACKET FOR ELECTRIC HEADLIGHTS. Charles E. Jones, New York, N. Y., assignor to the Dressel Railway Lamp Works, New York, N. Y. A support and reflector for headlights.



864,713.—TELEPHONE REPEATING SYSTEM.

864,571. TROLLEY HARP. Thomas W. Small, Cleveland, Ohio, assignor, by mesne assignments, to the Acme Automatic Street Indicating Company, Cleveland, Ohio. Guards extending under the wheel flanges are provided.

864,695. RECTIFYING AND INTERRUPTING ALTERNATING CURRENTS. Otto Rothenstein, Chicago, Ill. An electrolytic rectifier.

864,713. TELEPHONE REPEATER SYSTEM. Nathaniel G. Warth, Columbus, Ohio. A bridge at the repeater station divides the main circuit into two associated repeater line sections.